Table 4-3. Parcel C Remedial Action Summary and Expected Outcomes

Media	Risk/Basis for Action	Reasonably Anticipated Land Use	RAO	Remedy Component	Performance Metric	Expected Outcome
Soil	**Human Health:** Unacceptable risk to potential future industrial users from exposure to metals, VOCs, and SVOCs in soil; recreational users from exposure to metals and SVOCs in soil; residents (adult and child) from metals, VOCs, SVOCs, pesticides, and PCBs in soil; and construction workers from metals, SVOCs, and PCBs in soil. Potential volatilization of VOCs and some SVOCs from soil into soil gas and/or indoor air via the VI pathway.	**Current use:** Limited access unoccupied and unused buildings **Planned future use**: Multiuse, including areas of predominantly arts-related, commercial, retail and residential, research and development, and shoreline open space	1. Prevent or minimize exposure to organic and inorganic chemicals in soil at concentrations above remediation goals developed in the HHRA for the following exposure pathways: a. Ingestion of, outdoor inhalation of, and dermal exposure to surface and subsurface soil. b. Ingestion of homegrown produce in native soil.	Excavation	Excavation to remove COCs in soil that exceeded RGs and action levels established in the 2014 ESD (Navy, 2014). Completed in 2015.	Land suitable for planned future use compatible with durable covers and ICs as required by the LUC RD.
				Durable covers	Durable covers to provide physical barriers to prevent exposure to metals in soil. Durable covers include: 1) a 3-foot-thick (minimum) shoreline armoring, 2) a 2-foot-thick (minimum) vegetated soil cover, 3) a 6-inch-thick (minimum) asphaltic pavement cover, and 4) repaired concrete building foundations. Covers are inspected and maintained to prevent exposure to COCs.	
				ICs	ICs to maintain durable covers, restrict land use and land-disturbing activity, and prohibit growing vegetables or fruits in native soil for human consumption	
Soil Gas			2. Prevent or minimize exposure to VOCs in soil gas at concentrations that would pose unacceptable risk via indoor inhalation of vapors. Table 7 of the final soil gas memorandum (ChaduxTt, 2010) lists the volatile chemicals. This list includes SVOCs (such as pesticides and PAHs). Remediation goals for VOCs to address exposure via indoor inhalation of vapors may be superseded based on COC identification information from future soil gas surveys. Future action levels would be established for soil gas, would account for vapors from both soil and groundwater, and would be calculated based on a cumulative excess cancer risk level of 10^{-6} using the accepted methodology for risk assessments at HP[N]S.	SVE	SVE to remove VOCs from soil gas. Five SVE systems within RU-C1, RU-C2, RU-C4, and RU-C5 were operated from 2014 to 2017 with limited success due to shallow groundwater table, low permeability soil/sediment, water entrainment in the SVE wells, and ongoing remedial actions that may contribute to ineffectiveness of removal. The Navy is in the process of reviewing the strategy for addressing soil vapor exceedances at all Parcel C Areas in conjunction with additional in-situ groundwater remediation activities that are ongoing.	
				ICs	ICs to prohibit construction of enclosed structures unless prior written approval of vapor mitigation strategies is granted by the FFA signatories.	
Groundwater	**Human Health:** Potential volatilization of VOCs from soil and A-aquifer groundwater into soil gas and/or indoor air via the VI pathway. Potential unacceptable risks to future construction workers from dermal exposure to COCs in A-aquifer groundwater and VOCs through volatilization in trenches. Potential unacceptable risks to residents through COCs in B-aquifer groundwater from domestic use (RU-C5 only).		1. Prevent or minimize exposure to VOCs in the A-aquifer groundwater at concentrations above remediation goals via indoor inhalation of vapors from groundwater. 2. Prevent or minimize direct exposure to the groundwater that may contain COCs through the domestic use pathway in the B-aquifer, RU-C5 only (for example, drinking water or showering). 3. Prevent or minimize exposure of construction workers to metals and VOCs in the A-aquifer groundwater at concentrations above remediation goals from dermal exposure and inhalation of vapors from groundwater.	Groundwater treatment	In-situ groundwater remediation to active treatment criteria consisting of injecting ZVI or a biological substrate to treat COCs (VOCs and hexavalent chromium) in RU-C1, RU-C2, RU-C4, and RU-C5. The first round of injections was conducted from 2013 to 2017 and the latest round was in 2021. Performance monitoring is ongoing for plumes that have not met MNA criteria (COCs statistically below ATCs). Additional treatment, moving to MNA, or plume closure is determined through decision criteria that were established in the RD.	
				MNA	Upon completion of groundwater treatment, MNA will be conducted to monitor COC degradation, aquifer conditions, and plume stability until RGs are met.	
				ICs	ICs to prohibit construction of enclosed structures, the use of groundwater and installation of new groundwater wells for domestic purposes, and to restrict land-disturbing activity unless prior written approval is granted by the FFA signatories	

Table 4-3. Parcel C Remedial Action Summary and Expected Outcomes

Media	Risk/Basis for Action	Reasonably Anticipated Land Use	RAO	Remedy Component	Performance Metric	Expected Outcome
Groundwater	Potential migration pathway of contaminants	**Current use:** limited access unoccupied and unused buildings **Planned future use**: Multiuse, including areas of predominantly arts-related, commercial, retail and residential, research and development, and shoreline open space	4. Prevent or minimize migration to the surface water of San Francisco Bay of chromium VI and zinc in A-aquifer groundwater that would result in concentrations of chromium VI above 50 µg/L and zinc above 81 µg/L at the point of discharge to the bay.	Groundwater treatment and monitoring	In-situ groundwater remediation consisting of injecting food-grade molasses was completed in RU-C3 and RU-C5 to reduce hexavalent chromium via anaerobic bioremediation. Zinc was initially targeted for active remediation but was documented not to be warranted based on pre-remedial characterization sampling. Concentrations are below treatment goals.	Land suitable for planned future use compatible with durable covers and ICs as required by the LUC RD.
				LTM	Groundwater LTM to monitor hexavalent chromium and zinc concentrations and migration. LTM will continue until concentrations are below TLs protective of the bay.	
Radiologically Impacted Soil and Structures	**Human Health:** Radiological risks for soil and structures (storm drains, sanitary sewers, buildings) were greater than 10^{-6}.		1. Prevent or minimize exposure to radionuclides of concern in concentrations that exceed remediation goals for all potentially complete exposure pathways (for example, external radiation, soil ingestion, and inhalation of resuspended radionuclides in soil or dust).	Survey, decontamination, and removal of radiologically impacted structures and soil	Identification and removal of historical subsurface storm drain and sanitary sewer utilities and screening and remediation of buildings, and former building sites as part of the TCRA for radionuclides. Radiological retesting is currently being conducted to confirm site conditions are compliant with the RAO.	

References:

ChaduxTt, A Joint Venture of St. George Chadux Corp. and Tetra Tech EM Inc. (ChaduxTt). 2010. *Memorandum: Approach for Developing Soil Gas Action Levels for Vapor Intrusion Exposure at Hunters Point Shipyard, Hunters Point Shipyard, San Francisco, California*.

Navy. 2014. *Explanation of Significant Differences to the Final Record of Decision for Parcel C, Hunters Point Shipyard, San Francisco, California.* Final. October.

µg/L = microgram(s) per liter
ATC = active treatment criterion
COC = chemical of concern
ESD = Explanation of Significant Differences
FFA = Federal Facilities Agreement
HHRA = human health risk assessment
HPNS = Hunters Point Naval Shipyard
IC = institutional control
LTM = long-term monitoring
LUC = land use control
MNA = monitored natural attenuation
Navy = Department of the Navy
PAH = polycyclic aromatic hydrocarbon
PCB = polychlorinated biphenyl
RAO = remedial action objective
RD = remedial design
RG = remediation goal
SVE = soil vapor extraction
SVOC = semivolatile organic compound
TCRA = time-critical removal action
VI = vapor intrusion
VOC = volatile organic compound
ZVI = zero-valent iron

Table 4-4. Parcel UC-2 Remedial Action Summary and Expected Outcomes

Media	Risk/Basis for Action	Reasonably Anticipated Land Use	RAO	Remedy Component	Performance Metric	Expected Outcome
Soil	**Human Health:** Unacceptable risk to potential future residents (adult and child) and construction workers from metals in soil. Potential volatilization of VOCs and some SVOCs from soil into soil gas and/or indoor air via the VI pathway.	**Current use:** Utility corridor, access road, unused buildings. **Planned future use:** Multiuse, including mixed residential, arts, commercial, retail, and research and development (industrial)	1. Prevent or minimize exposure to inorganic chemicals in soil at concentrations above remediation goals developed in the HHRA for the following exposure pathways: a) Ingestion of, outdoor inhalation of, and dermal exposure to surface and subsurface soil b) Ingestion of homegrown produce by residents in mixed-use and research and development blocks	Durable covers	Durable covers (asphalt pavement or vegetated soil) to provide physical barriers to prevent exposure to metals in soil. Durable covers include: 1) a 2-foot-thick (minimum) vegetated soil cover, 2) a 6-inch-thick (minimum) asphaltic pavement cover, and 3) repaired concrete building foundations. Covers are inspected and maintained to prevent exposure to COCs.	Land suitable for planned future use compatible with durable covers and ICs as required by the LUC RD.
				ICs	ICs to maintain durable covers, restrict land use and land-disturbing activity, and prohibit growing vegetables or fruits in native soil for human consumption	
Soil Gas			2. Prevent or minimize exposure to VOCs in soil gas at concentrations that would pose unacceptable risk via indoor inhalation of vapors. Remediation goals for VOCs to address exposure via indoor inhalation of vapors may be superseded based on COC identification information from future soil gas surveys. Future action levels would be established for soil gas, would account for vapors from both soil and groundwater, and would be calculated based on a cumulative risk level of 10^{-6} using the accepted methodology for risk assessments at HP[N]S.	ICs	ICs to prohibit construction of enclosed structures unless prior written approval of vapor mitigation strategies is granted by the FFA signatories.	
Groundwater	**Human Health:** Risk to potential future residents from VOCs in A-aquifer through the vapor intrusion pathway, construction workers through vapors in trenches.		1. Prevent or minimize exposure to VOCs in the A-aquifer groundwater at concentrations above remediation goals via indoor inhalation of vapors from groundwater. 2. Prevent or minimize direct exposure to the groundwater that may contain COCs through the domestic use pathway (for example, drinking water or showering). 3. Prevent or minimize exposure of construction workers to VOCs in the A-aquifer groundwater at concentrations above remediation goals from dermal exposure and inhalation of vapors from groundwater.	LTM	LTM of groundwater is conducted to monitor COC concentrations in groundwater. Parcel UC-2 has been transferred to the City of San Francisco and is no longer on Navy property. Monitoring of these two wells will continue semiannually to assess trends in concentrations of carbon tetrachloride and chloroform at Parcel UC-2; no remedial action for groundwater treatment is required at this time. Ownership of Parcel UC-2 has been transferred to the City of San Francisco and is no longer Navy property; however, sampling of the monitoring wells is still included in the BGMP.	
				ICs	ICs to prohibit construction of enclosed structures, the use of groundwater and installation of new groundwater wells for domestic purposes, and to restrict land-disturbing activity unless prior written approval is granted by the FFA signatories.	
Radiologically Impacted Soil and Structures	**Human Health:** Radiological risks for soil and structures (storm drains and sanitary sewers) were greater than 10^{6}.		1. Prevent or minimize exposure to radionuclides of concern in concentrations that exceed remediation goals for all potentially complete exposure pathways (for example, external radiation, soil ingestion, and inhalation of resuspended radionuclides in soil or dust).	Survey, decontamination, and removal of radiologically impacted structures and soil	Identification and removal of historical subsurface storm drain and sanitary sewer utilities and screening and remediation of buildings, and former building sites as part of the TCRA for radionuclides. Radiological retesting is planned to confirm site conditions are compliant with the RAO.	

Table 4-4. Parcel UC-2 Remedial Action Summary and Expected Outcomes

BGMP = Basewide Groundwater Monitoring Program
COC = chemical of concern
FFA = Federal Facilities Agreement
HHRA = human health risk assessment
HPNS = Hunters Point Naval Shipyard
IC = institutional control
LTM = long-term monitoring
LUC = land use control
Navy = Department of the Navy
RAO = remedial action objective
RD = remedial design
SVOC = semivolatile organic compound
TCRA = time-critical removal action
VI = vapor intrusion
VOC = volatile organic compound

Table 4-5. Fourth Five-Year Review Parcel C and UC-2 Issues, Recommendations, and Follow-up Actions

Parcel/Site	Fourth Five-Year Review Protectiveness	Issue	Recommendation (Milestone)	Date Complete/Current Status
C	Will be protective	SVE implementation in Parcels B-1 and C is reducing source mass, but with limited effectiveness due to diffusion-limited conditions in the subsurface. Although ICs will maintain future protectiveness, source removal inefficiency is extending the period within which SVE will be implemented.	It is recommended that use of the SVE technology be evaluated for each treatment area due to inefficiency caused by diffusion-limited conditions. Site-specific studies (e.g., remedy analyses) should be performed to estimate the magnitude and extent of source mass at each treatment area in Parcels B-1 and C to determine if other measures could be implemented to enhance SVE performance in the future. Any changes implemented to the approach for reducing source contamination in SVE areas should be discussed in the next Five-Year Review report. Changes made to the treatment approach should be considered for any other SVE treatment areas at HPNS, including areas where treatment is planned but has not yet been initiated. (12/31/2019)	**Completed February 2019:** The SVE systems at Parcel C were turned off between 2016 and 2017 when they reached points of diminishing returns primarily because of shallow groundwater, low permeability soils, and additional remedial actions pending in the treatment areas. The Navy will review the strategy for addressing soil gas at all Parcel C Areas after completion of additional in-situ groundwater remediation activities that are ongoing and discussed in **Section 4.4.1** of this Five-Year Review (ECC-Insight and CDM Smith, 2019).
C and UC-2	Will be protective (C) Short-term protective (UC-2)	The Navy has determined that a significant portion of the radiological survey and remediation work completed to date was not reliable because of manipulation and/or falsification of data by one of its radiological contractors. A long-term protectiveness evaluation of the radiological RGs has not yet been completed for this fourth Five-Year Review, and it is currently not known if the RAOs for radionuclides have been achieved in Parcels B-1, B-2, C, D-1, D-2, G, E, UC-1, UC-2, and UC-3.	Refer to **Section 1.4.3** for the long-term protectiveness evaluation component of this recommendation. The Navy is in the process of implementing corrective actions to ensure that the radiological remedies specified in the decision documents are implemented as intended. It is anticipated that the radiological rework will be completed prior to the next Five-Year Review.	**Long-term Protectiveness Evaluation:** Completed June 2020. Addenda to the Fourth Five-Year Review were prepared to evaluate the Radiological RGs for soil and buildings. The conclusions of both reports were that the current RGs were protective of human health and the environment (Navy, 2020a, 2020b). **In Progress:** Planning for the radiological retesting of soil and surveys of building structures at Parcel C was initiated in February 2019. Fieldwork activities were initiated in Spring 2022. Radiological retesting will be summarized in a radiological RACR anticipated to be completed in 2025. Planning for the radiological retesting of soil at Parcel UC-2 was initiated in February 2019. Fieldwork began in 2023. Radiological retesting will be summarized in a radiological RACR anticipated to be completed in 2028.

References:

Department of the Navy (Navy). 2020a. *Addendum to the Five-Year Review, Evaluation of Radiological Remedial Goals for Soil, Hunters Point Naval Shipyard, San Francisco, California.* June 18.

Navy. 2020b. *Addendum to the Five-Year Review, Evaluation of Radiological Remedial Goals for Building Structures, Hunters Point Naval Shipyard, San Francisco, CA*. June 18.

ECC-Insight, LLC and CDM Smith. 2019. *Parcel C Soil Vapor Extraction System Operation and Maintenance Summary Report, Hunters Point Naval Shipyard, San Francisco, California*. Final. February.

HPNS = Hunters Point Naval Shipyard
IC = institutional control
Navy = Department of the Navy
RACR = Remedial Action Completion Report
RAO = remedial action objective
RG = remediation goal
SVE = soil vapor extraction

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Table 4-6. Parcels C and UC-2 Chemicals of Concern and Current Comparison Criteria for Groundwater

Exposure Medium	Exposure Scenario	Chemical of Concern	Values from ROD			Current Comparison Criteria				
			ROD Remediation Goal (2009/2010)	Source of Remediation Goal	Parcel	11/2022 USEPA RSL or VISL[a]	Basis of RSL or VISL (C/NC)	DTSC-SL	California MCL	USEPA MCL
A-Aquifer (µg/L)	Residential Vapor Intrusion	1,1,2,2-Tetrachloroethane	3	RBC	C	3.23	C	NA	1	NA
		1,1,2-Trichloroethane	4	RBC	C	5.21	C	NA	5	5
		1,1-Dichloroethane	6.5	RBC	C	7.64	C	NA	5	NA
		1,2,3-Trichloropropane	0.5	PQL	C	22.3	NC	NA	0.005	NA
		1,2,4-Trimethylbenzene	25	RBC	C	248	NC	NA	NA	NA
		1,2-Dichlorobenzene	2,600	RBC	C	2660	NC	NA	600	600
		1,2-Dichloroethane	2.3	RBC	C	2.24	C	NA	0.5	5
		1,2-Dichloroethene (Total)	210	RBC	C	109	NC	NA	6 / 10	70 / 100
		1,2-Dichloropropane	1.1	RBC	C	6.58	C	NA	5	5
		1,3,5-Trimethylbenzene	19	RBC	C	175	NC	NA	NA	NA
		1,4-Dichlorobenzene	2.1	RBC	C	2.59	C	NA	5	75
		Benzene	0.5	PQL	C	1.59	C	NA	1	5
		Bromodichloromethane	1	RBC	C	0.876	C	NA	80	80
		Carbon Tetrachloride	0.5	PQL	C, UC-2	0.415	C	NA	0.5	5
		Chlorobenzene	390	RBC	C	410	NC	NA	70	100
		Chloroethane	6.5	RBC	C	9190	NC	NA	NA	NA
		Chloroform	0.7	RBC	C, UC-2	0.814	C	NA	80	80
		cis-1,2-Dichloroethene	210	RBC	C	250	NC	NA	6	70
		cis-1,3-Dichloropropene	0.5	PQL	C	4.84	C	NA	0.5	NA
		Dibromochloromethane	2.6	RBC	C	NITD		NA	80	80
		Isopropylbenzene	7.8	RBC	C	887	NC	NA	NA	NA
		Methylene Chloride	27	RBC	C	763	C	NA	5	5
		Naphthalene	3.6	RBC	C	4.59	C	NA	NA	NA
		Tetrachloroethene	0.54	RBC	C	14.9	C	NA	5	5
		trans-1,2-Dichloroethene	180	RBC	C	109	NC	NA	10	100
		trans-1,3-Dichloropropene	0.5	PQL	C	4.84	NC	NA	0.5	NA
		Trichloroethene	2.9	RBC	C, UC-2	1.19	C	NA	5	5
		Trichlorofluoromethane	180	RBC	C	NITD		NA	150	NA
		Vinyl Chloride	0.5	PQL	C	0.147	C	NA	0.5	2

Table 4-6. Parcels C and UC-2 Chemicals of Concern and Current Comparison Criteria for Groundwater

Exposure Medium	Exposure Scenario	Chemical of Concern	Values from ROD			Current Comparison Criteria				
			ROD Remediation Goal (2009/2010)	Source of Remediation Goal	Parcel	11/2022 USEPA RSL or VISL[a]	Basis of RSL or VISL (C/NC)	DTSC-SL	California MCL	USEPA MCL
A-Aquifer (µg/L)	Industrial - Vapor Intrusion	1,1,2,2-Tetrachloroethane	5.1	RBC	C	14.1	C	NA	1	NA
		1,1,2-Trichloroethane	6.7	RBC	C	22.8	C	NA	5	5
		1,1-Dichloroethane	11	RBC	C	33.4	C	NA	5	NA
		1,2,3-Trichloropropane	0.5	PQL	C	93.7	NC	NA	0.000005	NA
		1,2,4-Trimethylbenzene	25	RBC	C	1040	NC	NA	NA	NA
		1,2-Dichloroethane	3.9	RBC	C	9.78	C	NA	0.5	5
		1,2-Dichloroethene (Total)	210	RBC	C	457	NC	NA	6 / 10	70 / 100
		1,2-Dichloropropane	1.8	RBC	C	28.7	C	NA	5	5
		1,3,5-Trimethylbenzene	19	RBC	C	733	NC	NA	NA	NA
		1,4-Dichlorobenzene	3.6	RBC	C	11.3	C	NA	5	75
		Benzene	0.63	RBC	C	6.93	C	NA	1	5
		Bromodichloromethane	1.7	RBC	C	3.82	C	NA	80	80
		Carbon Tetrachloride	0.5	PQL	C	1.81	C	NA	0.5	5
		Chlorobenzene	390	RBC	C	1720	NC	NA	70	100
		Chloroform	1.2	RBC	C	3.55	C	NA	80	80
		cis-1,2-Dichloroethene	210	RBC	C	1050	NC	NA	6	70
		cis-1,3-Dichloropropene	0.5	PQL	C	21.1	C	NA	0.5	NA
		Isopropylbenzene	7.8	RBC	C	3730	NC	NA	NA	NA
		Methylene Chloride	46	RBC	C	9230	C	NA	5	5
		Naphthalene	6	RBC	C	20.1	C	NA	NA	NA
		Tetrachloroethene	0.9	RBC	C	65.2	C	NA	5	5
		trans-1,3-Dichloropropene	0.5	PQL	C	21.1	C	NA	0.5	NA
		Trichloroethene	4.8	RBC	C	7.4	C	NA	5	5
		Trichlorofluoromethane	180	RBC	C	NITD		NA	150	NA
		Vinyl Chloride	0.5	PQL	C	2.45	C	NA	0.5	2
	Construction Worker	1,1,2-Trichloroethane	40	RBC	C	NA	NA	NA	NA	NA
		1,2,3-Trichloropropane	0.6	RBC	C	NA	NA	NA	NA	NA
		1,2,4-Trichlorobenzene	41	RBC	C	NA	NA	NA	NA	NA
		1,2,4-Trimethylbenzene	53	RBC	C	NA	NA	NA	NA	NA
		1,2-Dichlorobenzene	1700	RBC	C	NA	NA	NA	NA	NA
		1,2-Dichloroethane	22	RBC	C	NA	NA	NA	NA	NA
		1,2-Dichloroethene (Total)	270	RBC	C	NA	NA	NA	NA	NA
		1,2-Dichloropropane	30	RBC	C	NA	NA	NA	NA	NA
		1,4-Dichlorobenzene	52	RBC	C	NA	NA	NA	NA	NA

Table 4-6. Parcels C and UC-2 Chemicals of Concern and Current Comparison Criteria for Groundwater

Exposure Medium	Exposure Scenario	Chemical of Concern	Values from ROD			Current Comparison Criteria				
			ROD Remediation Goal (2009/2010)	Source of Remediation Goal	Parcel	11/2022 USEPA RSL or VISL[a]	Basis of RSL or VISL (C/NC)	DTSC-SL	California MCL	USEPA MCL
A-Aquifer (µg/L)	Construction Worker	Benzene	16	RBC	C	NA	NA	NA	NA	NA
		Bromodichloromethane	19	RBC	C	NA	NA	NA	NA	NA
		Carbon Tetrachloride	15	RBC	C, UC-2	NA	NA	NA	NA	NA
		Chlorobenzene	450	RBC	C	NA	NA	NA	NA	NA
		Chloroform	26	RBC	C	NA	NA	NA	NA	NA
		cis-1,2-Dichloroethene	270	RBC	C	NA	NA	NA	NA	NA
		Naphthalene	16	RBC	C	NA	NA	NA	NA	NA
		Tetrachloroethene	18	RBC	C	NA	NA	NA	NA	NA
		Trichloroethene	290	RBC	C	NA	NA	NA	NA	NA
		Vinyl Chloride	5.4	RBC	C	NA	NA	NA	NA	NA
		2,4-Dimethylphenol	9800	RBC	C	NA	NA	NA	NA	NA
		2,4-Dinitrotoluene	180	RBC	C	NA	NA	NA	NA	NA
		3,4-Dimethylphenol	700	RBC	C	NA	NA	NA	NA	NA
		4-Methylphenol	3500	RBC	C	NA	NA	NA	NA	NA
		Benzo(a)anthracene	0.67	RBC	C	NA	NA	NA	NA	NA
		Benzo(a)pyrene	0.05	RBC	C	NA	NA	NA	NA	NA
		Benzo(b)fluoranthene	0.45	RBC	C	NA	NA	NA	NA	NA
		Benzo(k)fluoranthene	0.45	RBC	C	NA	NA	NA	NA	NA
		Chrysene	6.7	RBC	C	NA	NA	NA	NA	NA
		Pentachlorophenol	50	PQL	C	NA	NA	NA	NA	NA
	Protection of the Environment	Chromium VI	50	SWC	C	NA	NA	NA	NA	NA
		Zinc	81	SWC	C	NA	NA	NA	NA	NA
B-Aquifer (RU-C5 Plume Only) (µg/L)	Residential - Domestic Use	Chromium VI [b]	109	RBC [c]	C	0.035	C	NA	50	100
		Antimony	6	MCL	C	7.8	NC	NA	6	6
		Arsenic	10	MCL	C	0.052	C	0.0082	10	10
		Iron	10,950	RBC	C	14000	NC	NA	NA	NA
		Manganese	8,140	HGAL	C	430	NC	NA	NA	NA
		Thallium	2	MCL	C	0.2	NC	0.059	2	2
		1,1-Dichloroethane	5	MCL	C	2.8	C	2.8 (USEPA)	5	NA
		1,2,4-Trichlorobenzene	70	MCL	C	1.2	C	0.46	5	70
		1,2,4-Trimethylbenzene	12	RBC	C	56	NC	NA	NA	NA
		1,2-Dichlorobenzene	600	MCL	C	30	NC	NA	600	600
		1,2-Dichloroethane	0.5	MCL	C	0.17	C	0.17 (USEPA)	0.5	5
		1,2-Dichloroethene (Total)	6	MCL	C	25	NC	6 / 10	6 / 10	70 / 100

Table 4-6. Parcels C and UC-2 Chemicals of Concern and Current Comparison Criteria for Groundwater

Exposure Medium	Exposure Scenario	Chemical of Concern	Values from ROD			Current Comparison Criteria				
			ROD Remediation Goal (2009/2010)	Source of Remediation Goal	Parcel	11/2022 USEPA RSL or VISL[a]	Basis of RSL or VISL (C/NC)	DTSC-SL	California MCL	USEPA MCL
B-Aquifer (RU-C5 Plume Only) (µg/L)	Residential - Domestic Use	1,2-Dichloropropane	5	MCL	C	0.85	C	NA	5	5
		1,3,5-Trimethylbenzene	12	RBC	C	60	NC	NA	NA	NA
		1,3-Dichlorobenzene	183	RBC [c]	C	NA	NA	NA	NA	NA
		1,4-Dichlorobenzene	5	MCL	C	0.48	C	NA	5	75
		Benzene	1	MCL	C	0.46	C	0.15	1	5
		Bromodichloromethane	80	MCL	C	0.13	C	0.13 (USEPA)	80	80
		Chlorobenzene	70	MCL	C	78	NC	NA	70	100
		Chloroethane	4.6	RBC [c]	C	8300	NC	NA	NA	NA
		Chloroform	80	MCL	C	0.22	C	NA	80	80
		cis-1,2-Dichloroethene	6	MCL	C	25	NC	12	6	70
		Methylene Chloride	5	MCL	C	11	C	1.7	5	5
		Naphthalene	0.093	RBC	C	0.12	C	0.12	NA	NA
		Tetrachloroethene	5	MCL	C	11	C	0.084	5	5
		trans-1,2-Dichloroethene	10	MCL	C	68	NC	110	10	100
		Trichloroethene	5	MCL	C	0.49	C	NA	5	5
		Trichlorofluoromethane	1,288	RBC	C	5200	NC	1700	150	NA
		Vinyl Chloride	0.5	MCL	C	0.019	C	0.0098	0.5	2
		2,4-Dimethylphenol	730	RBC [c]	C	360	NC	NA	NA	NA
		2,4-Dinitrotoluene	10	RBC [c]	C	0.24	C	0.11 (USEPA)	NA	NA
		2-Methylnaphthalene	24	RBC [c]	C	36	NC	17	NA	NA
		2-Methylphenol	1,825	RBC [c]	C	930	NC	NA	NA	NA
		4-Methylphenol	182	RBC [c]	C	370	NC	NA	NA	NA
		Benzo(a)anthracene	0.2	RBC [c]	C	0.03	C	0.017	NA	NA
		Benzo(a)pyrene	0.2	MCL	C	0.025	C	NA	0.2	0.2
		Bis(2-ethylhexyl)phthalate	4	MCL	C	5.6	C	NA	4	6
		Carbazole	10	RBC [c]	C	NA		NA	NA	NA
		Chrysene	0.2	RBC [c]	C	25	C	NA	NA	NA
		Dibenzofuran	12	RBC [c]	C	7.9	NC	4	NA	NA
		Hexachloroethane	1.7	RBC [c]	C	0.33	C	NA	NA	NA
		Pentachlorophenol	1	MCL	C	0.041	C	NA	1	1
		Aldrin	0.05	RBC [c]	C	0.00092	C	0.0092 (USEPA)	NA	NA
		alpha-BHC	1	RBC [c]	C	0.0072	C	0.011	NA	NA
		Dieldrin	0.02	RBC [c]	C	0.0018	C	0.00066 (USEPA)	NA	NA
		Heptachlor Epoxide	0.01	MCL	C	0.0014	C	0.0014 (USEPA)	0.01	0.2

Table 4-6. Parcels C and UC-2 Chemicals of Concern and Current Comparison Criteria for Groundwater

Exposure Medium	Exposure Scenario	Chemical of Concern	Values from ROD			Current Comparison Criteria				
			ROD Remediation Goal (2009/2010)	Source of Remediation Goal	Parcel	11/2022 USEPA RSL or VISL[a]	Basis of RSL or VISL (C/NC)	DTSC-SL	California MCL	USEPA MCL

[a] VISL presented for A-aquifer groundwater, RSL for B-aquifer groundwater.

[b] MCLs shown are for total chromium, no MCLs available for Chromium VI.

[c] Risk-based concentration was identified as "MCL" in the ROD.

Note:

Shading indicates current comparison criteria is lower than ROD Remediation Goal unless Remediation Goal is HGAL.

µg/L = microgram(s) per liter
BHC = benzene hexachloride
C = carcinogen
DTSC = California Department of Toxic Substances Control
HGAL = Hunters Point groundwater ambient level
MCL = maximum contaminant level
NA = not available
NC = noncarcinogen
NITD = no inhalation toxicity data
PQL = practical quantitation limit
RBC = risk-based concentration
ROD = Record of Decision
RSL = Regional Screening Level
SL = screening level
SWC = Surface Water Criteria
USEPA = United States Environmental Protection Agency
VISL = vapor intrusion screening level

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Table 4-7. Parcel C Chemicals of Potential Concern for Ecological Receptors - Groundwater

Exposure Medium	Exposure Scenario	Chemical of Concern	ROD Trigger Level (2008)	Source of Trigger Level	Receptor Basis	NRWQC (2023)	Basin Plan SF Bay (2019)	Value Still Protective?	Notes
Groundwater (µg/L)	Ecological Receptor	Chromium VI	50	NRWQC - CCC	aquatic organisms	50	50	Yes	Analyte was included in the monitoring due to detections at Dry Dock 2 and Building 253. Exceeding the trigger level does not indicate immediate risk but a potential exists if the plume migrates toward the bay. The trigger level is a risk based criteria for surface water exposures but is not an ARAR for ecological exposure to groundwater.
		Zinc	81	NRWQC - CCC	aquatic organisms	81	81	Yes	Analyte was included in the monitoring due to detections at RU-C1 wells. Exceeding the trigger level does not indicate immediate risk but a potential exists if the plume migrates toward the bay. The trigger level is a risk based criteria for surface water exposures but is not an ARAR for ecological exposure to groundwater.

µg/L = microgram(s) per liter
ARAR = applicable or relevant and appropriate requirement
CCC = Criterion Continuous Concentration
NRWQC = National Recommended Water Quality Criteria
ROD = Record of Decision

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Table 4-8. Parcel C and UC-2 Issues, Recommendations, and Follow-up Actions

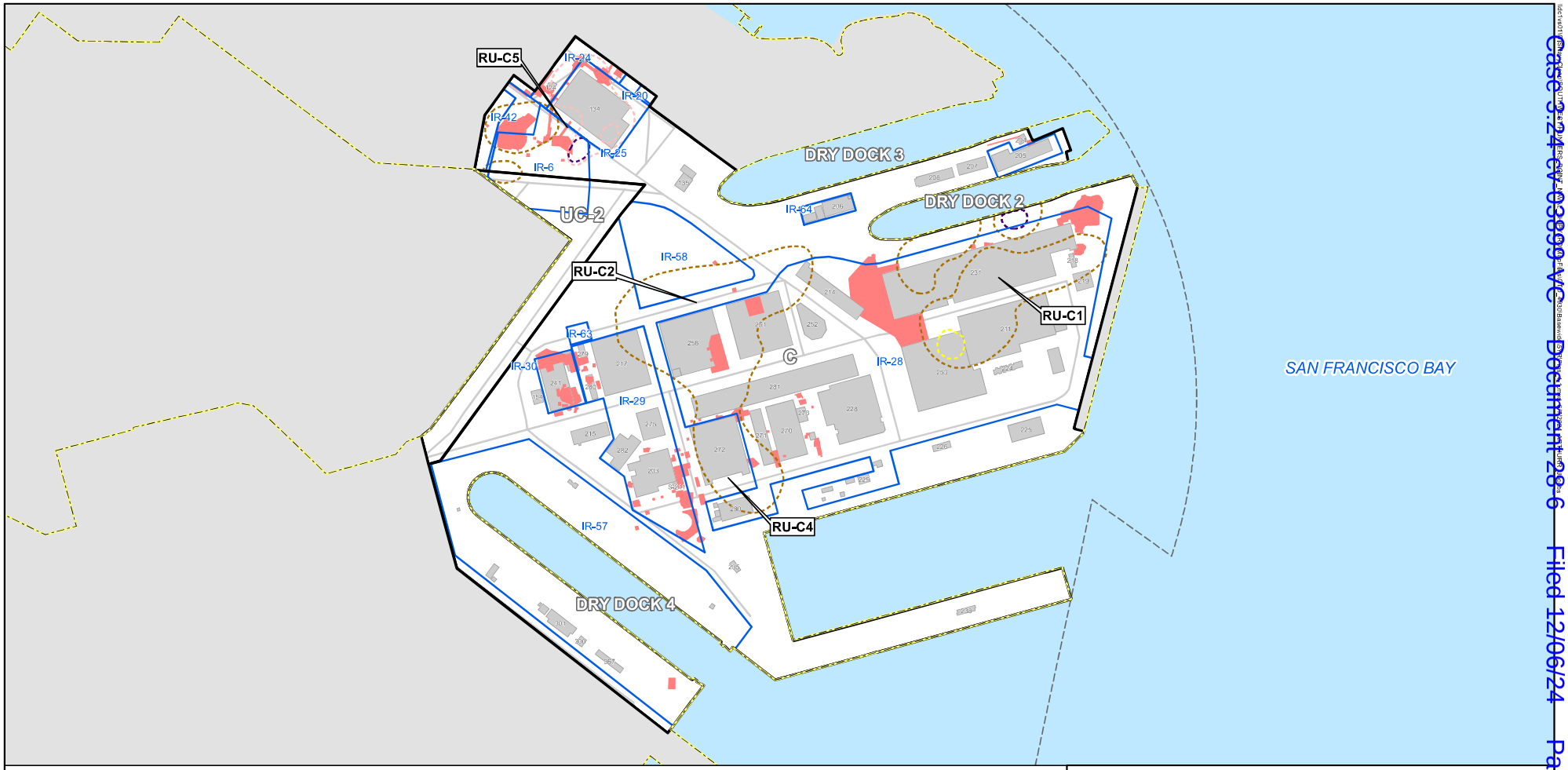
Parcel	Issue	Recommendations/ Actions	Party Responsible	Oversight Agency	Milestone Date	Affects Protectiveness (Y/N)	
						Current	Future
C	As identified in the Fourth Five-Year Review there is uncertainty with a portion of the radiological survey and remediation work performed between 2004 and 2016 under the Basewide Radiological Removal Action, Action Memorandum (Navy, 2006). The Navy is in the process of implementing corrective actions to ensure the radiological remedies specified in the decision documents were implemented as intended; however, this work is ongoing.	Complete radiological retesting at radiologically impacted sites, including current and former buildings and soil areas investigated under the Radiological Removal Action, Action Memorandum (Navy, 2006) and areas where evaluations determined previous data were unreliable.	Navy	USEPA	2/5/2025	N	Y
UC-2					3/2/2028		
C	There have been detections of COCs from A-aquifer groundwater within the B-aquifer and F-WBZ groundwater and the connection and communication between hydrogeologic units within Parcel C is not fully understood. Therefore, further characterization is required to demonstrate that remedies within the A-aquifer will be effective and not re-contaminated by COCs within the B-aquifer and deep F-WBZ and unacceptable discharges to the Bay are not and will not occur.	Complete investigations of the bay Mud/Sandy Lean Clay aquitard and extent of chemicals in the B-aquifer and F-WBZ, and use current ecological risk assessment methods and criteria to assess potential impacts to bay receptors. Where warranted, additional actions or changes to the remedy will be recommended at the conclusion of these investigations.	Navy	USEPA	5/31/2027 Interim Milestones: Five-Year Review Addendum 7/31/2025 Completion of F-WBZ investigation fieldwork 11/30/2025, Completion of F-WBZ investigation report 11/30/2026	Protectiveness Deferred	

Table 4-8. Parcel C and UC-2 Issues, Recommendations, and Follow-up Actions

Reference:

Navy. *2006. Base-wide Radiological Removal Action, Action Memorandum – Revision 2006, Hunters Point Shipyard, San Francisco, California*. Final. April 21.

Navy = Department of the Navy
TBD = to be determined
USEPA = United States Environmental Protection Agency

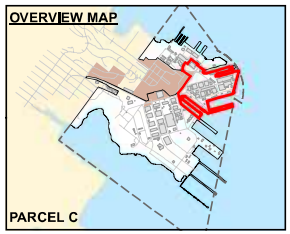


LEGEND

- Hunters Point Naval Shipyard Boundary
- Parcel Boundary
- Parcel F (Water) Boundary
- IR Site
- COC Excavation Area
- Water
- Building
- Road

Plume Detection Area

- Chromium VI
- Chromium VI, Zinc
- Naphthalene
- VOC



COC = chemical of concern
IR = Installation Restoration
RU = remediation unit
VOC = volatile organic compound

0 200 400 Feet
1 inch = 350 feet
N

Parcel C (Parcels C and UC-2)

Fifth Five-Year Review Report
Hunters Point Naval Shipyard, San Francisco, California

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Figure 4-1

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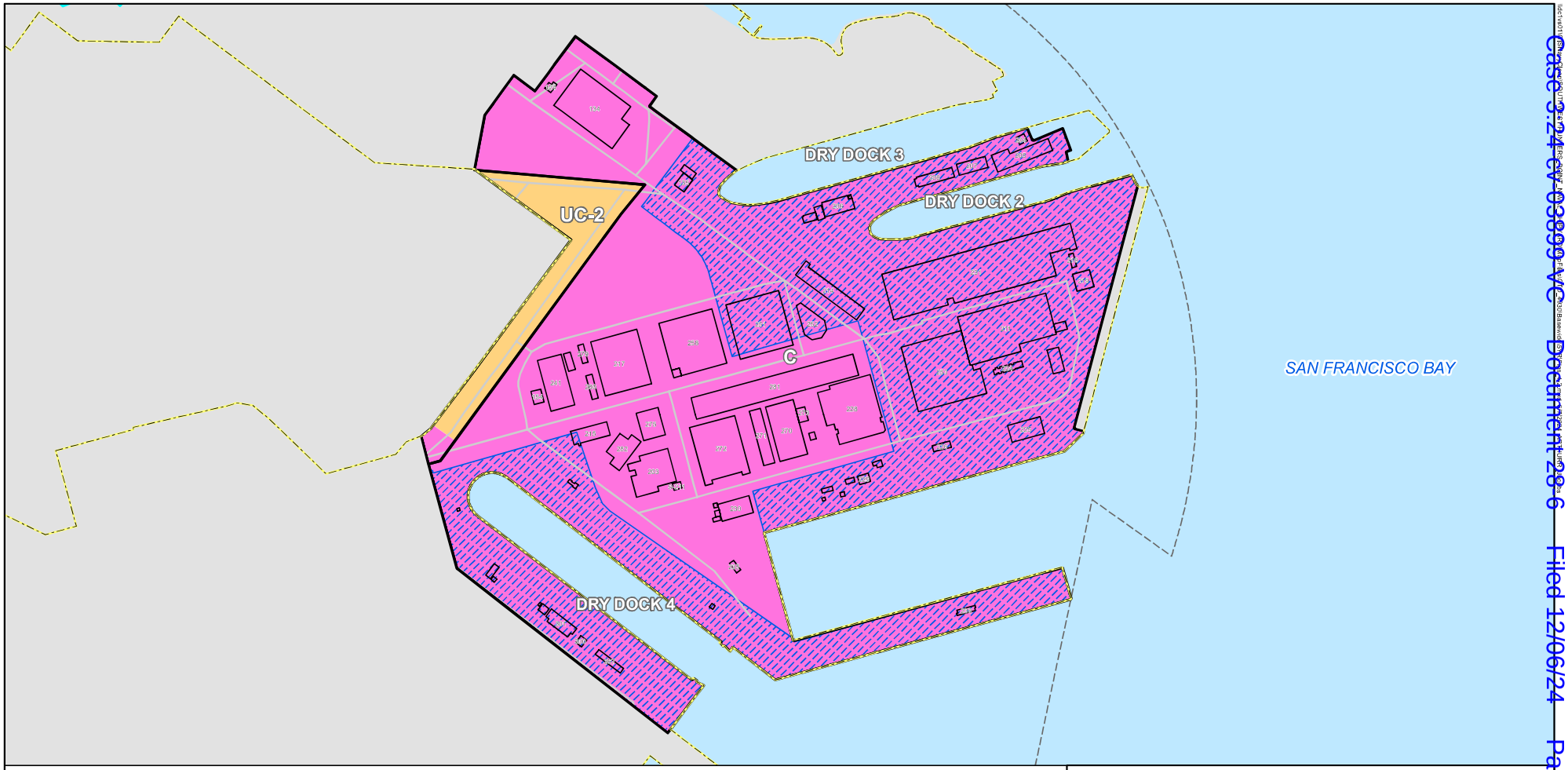
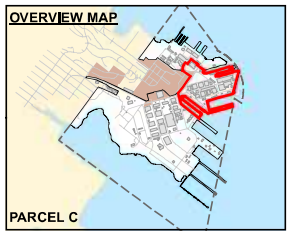


LEGEND

- Hunters Point Naval Shipyard Boundary
- Parcel Boundary
- Parcel F (Water) Boundary
- Water
- Building
- Road

Institutional Controls

- Additional Restrictions (Open Space, Educational/Cultural, and/or Maritime/Industrial Use
- ARIC for Soil and Groundwater Use (General)
- ARIC for Soil, Groundwater Use, and Restrictions Related to VOC Vapors



ARIC = area requiring institutional controls
VOC = volatile organic compound

0 175 350 Feet
1 inch = 350 feet

N

Parcel C (Parcels C and UC-2) Institutional Controls

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Figure 4-2

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LEGEND:

- BUILDING WITH FOUNDATION REPAIRED
- ASPHALTIC CONCRETE COVER
- ARMORED SHORELINE
- BUILDING SECURED (FOUNDATION NOT ACCESSIBLE)
- SWALE
- 2-FOOT SOIL COVER WITH VEGETATION
- MONITORING WELL IN EXTERIOR DURABLE COVER
- APPROXIMATE BOUNDARY OF SVE AREA (INSTALLED)
- APPROXIMATE BOUNDARY OF SVE AREA (PLANNED)
- APPROXIMATE BOUNDARY OF REMEDIAL UNIT
- APPROXIMATE BOUNDARY OF GROUNDWATER TREATMENT AREA
- PARCEL C BOUNDARY LINE
- OTHER PARCEL BOUNDARY LINE
- FENCE OR BARRIER
- UNDERGROUND STORM DRAIN LINE

N

0' 250'

Note:
1. The system at SVE Area 3 was expanded in 2016 to treat SVE Areas 4 and 5.
2. SVE Area 2 is pending completion of groundwater remediation in the area.

Source:
Innovex-ERRG Joint Venture. 2019. *Fourth Five-Year Review, Hunters Point Naval Shipyard, San Francisco, California.* Figure 6. July.

Figure 4-3
Overview of Remedy Components for Parcel C
Fifth Five-Year Review Report
Hunters Point Naval Shipyard
San Francisco, California

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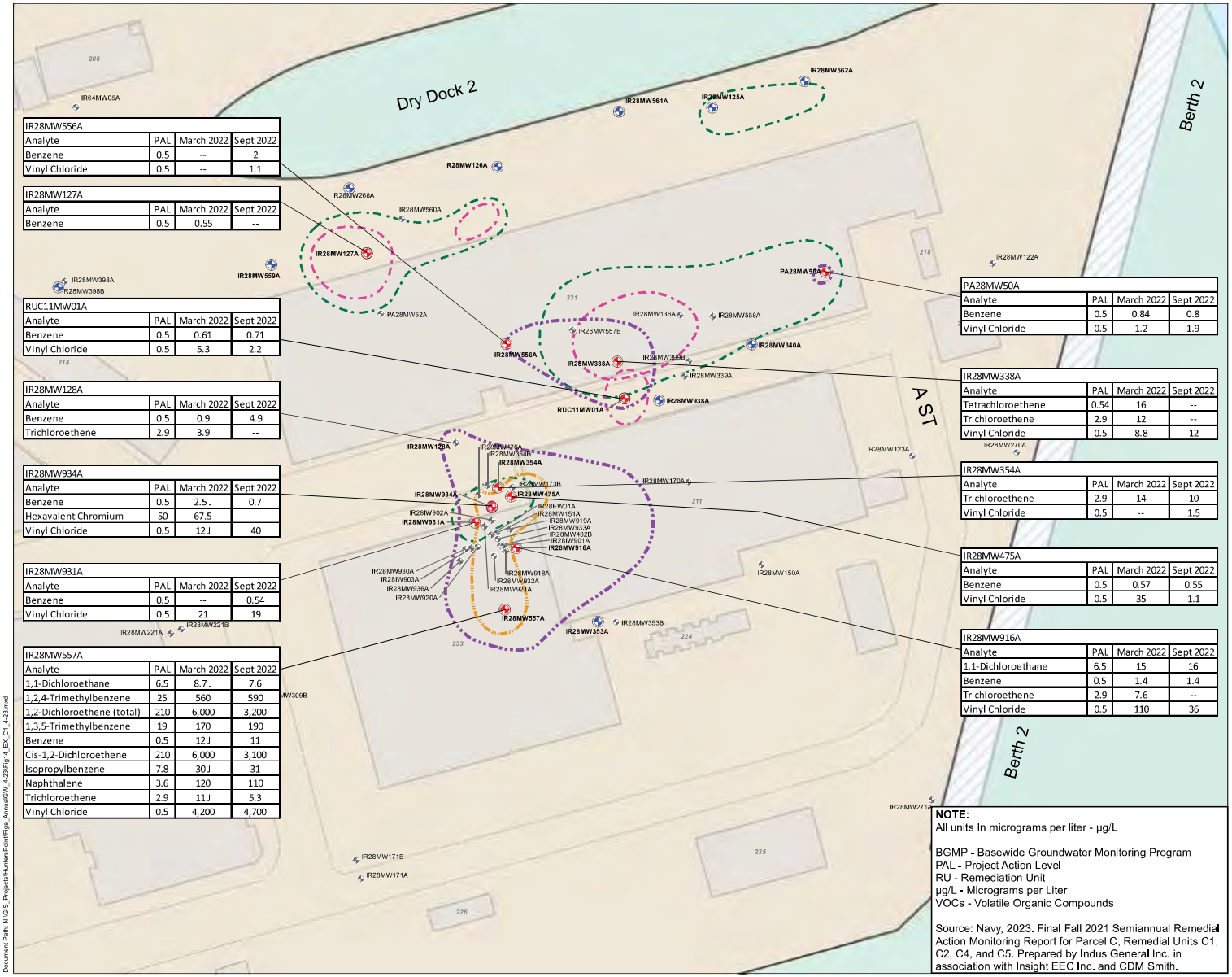


IR28MW556A			
Analyte	PAL	March 2022	Sept 2022
Benzene	0.5	--	2
Vinyl Chloride	0.5	--	1.1

IR28MW127A			
Analyte	PAL	March 2022	Sept 2022
Benzene	0.5	0.55	--

RUC11MW01A			
Analyte	PAL	March 2022	Sept 2022
Benzene	0.5	0.61	0.71
Vinyl Chloride	0.5	5.3	2.2

IR28MW128A			
Analyte	PAL	March 2022	Sept 2022
Benzene	0.5	0.9	4.9
Trichloroethene	2.9	3.9	--

IR28MW934A			
Analyte	PAL	March 2022	Sept 2022
Benzene	0.5	2.5 J	0.7
Hexavalent Chromium	50	67.5	--
Vinyl Chloride	0.5	12 J	40

IR28MW931A			
Analyte	PAL	March 2022	Sept 2022
Benzene	0.5	--	0.54
Vinyl Chloride	0.5	21	19

IR28MW557A			
Analyte	PAL	March 2022	Sept 2022
1,1-Dichloroethane	6.5	8.7 J	7.6
1,2,4-Trimethylbenzene	25	560	590
1,2-Dichloroethene (total)	210	6,000	3,200
1,3,5-Trimethylbenzene	19	170	190
Benzene	0.5	12 J	11
Cis-1,2-Dichloroethene	210	6,000	3,100
Isopropylbenzene	7.8	30 J	31
Naphthalene	3.6	120	110
Trichloroethene	2.9	11 J	5.3
Vinyl Chloride	0.5	4,200	4,700

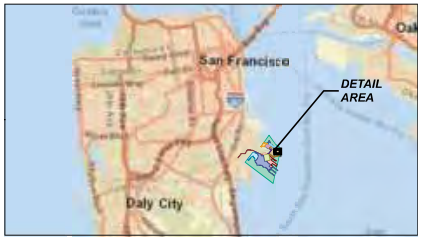
PA28MW50A			
Analyte	PAL	March 2022	Sept 2022
Benzene	0.5	0.84	0.8
Vinyl Chloride	0.5	1.2	1.9

IR28MW338A			
Analyte	PAL	March 2022	Sept 2022
Tetrachloroethene	0.54	16	--
Trichloroethene	2.9	12	--
Vinyl Chloride	0.5	8.8	12

IR28MW354A			
Analyte	PAL	March 2022	Sept 2022
Trichloroethene	2.9	14	10
Vinyl Chloride	0.5	--	1.5

IR28MW475A			
Analyte	PAL	March 2022	Sept 2022
Benzene	0.5	0.57	0.55
Vinyl Chloride	0.5	35	1.1

IR28MW916A			
Analyte	PAL	March 2022	Sept 2022
1,1-Dichloroethane	6.5	15	16
Benzene	0.5	1.4	1.4
Trichloroethene	2.9	7.6	--
Vinyl Chloride	0.5	110	36



LEGEND

- IR26MW51A — Monitoring Well exceeding remediation goals
- IR26MW71A — BGMP Monitoring Well
- IR26MW43A — Other Monitoring Well (Not Sampled)
- Roads

Parcels

- C
- F (Pier)
- Buildings
- F (Water)
- Approximate Area of Groundwater COC Plume that exceed RGs
- Approximate Area of Groundwater COC Plume that exceed ATCs
- Aerobic ISB Treatment
- Anaerobic ISB Treatment Area
- ZVI / Anaerobic ISB Treatment
- ZVI Treatment Area

GRAPHIC SCALE
0 100 FEET

NOTE:
All units In micrograms per liter - µg/L

BGMP - Basewide Groundwater Monitoring Program
PAL - Project Action Level
RU - Remediation Unit
µg/L - Micrograms per Liter
VOCs - Volatile Organic Compounds

Source: Navy, 2023. Final Fall 2021 Semiannual Remedial Action Monitoring Report for Parcel C, Remedial Units C1, C2, C4, and C5. Prepared by Indus General Inc. in association with Insight EEC Inc. and CDM Smith.

Source:
TRBW. 2023. *2022 Basewide Annual Groundwater Monitoring Report, Hunters Point Naval Shipyard, San Francisco, California.* December 2023. FINAL

Figure 4-4
March and September 2022 Exceedances of Remediation Goals in Parcel C Remedial Units C-1
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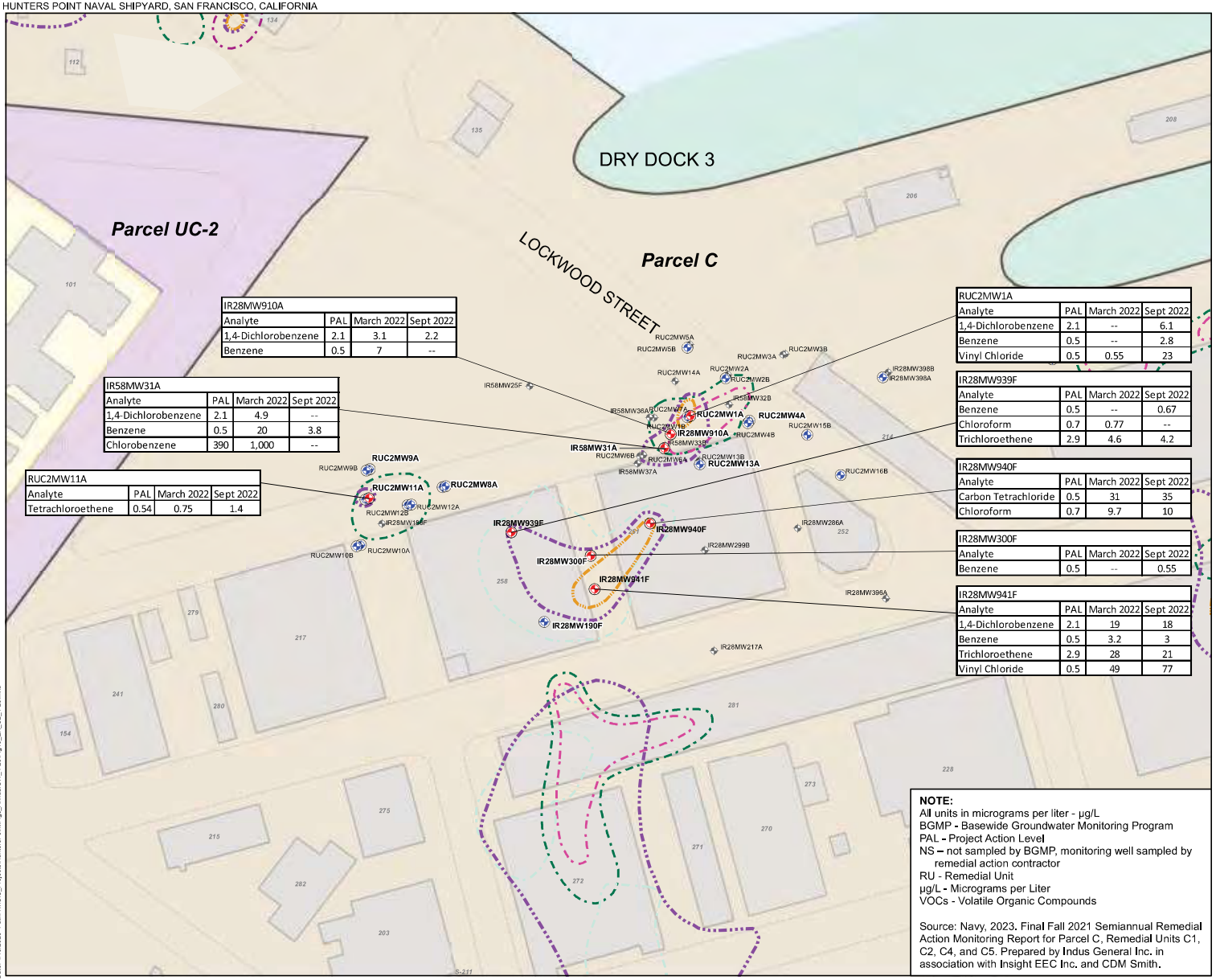

IR28MW910A			
Analyte	PAL	March 2022	Sept 2022
1,4-Dichlorobenzene	2.1	3.1	2.2
Benzene	0.5	7	--

IR58MW31A			
Analyte	PAL	March 2022	Sept 2022
1,4-Dichlorobenzene	2.1	4.9	--
Benzene	0.5	20	3.8
Chlorobenzene	390	1,000	--

RUC2MW11A			
Analyte	PAL	March 2022	Sept 2022
Tetrachloroethene	0.54	0.75	1.4

RUC2MW1A			
Analyte	PAL	March 2022	Sept 2022
1,4-Dichlorobenzene	2.1	--	6.1
Benzene	0.5	--	2.8
Vinyl Chloride	0.5	0.55	23

IR28MW939F			
Analyte	PAL	March 2022	Sept 2022
Benzene	0.5	--	0.67
Chloroform	0.7	0.77	--
Trichloroethene	2.9	4.6	4.2

IR28MW940F			
Analyte	PAL	March 2022	Sept 2022
Carbon Tetrachloride	0.5	31	35
Chloroform	0.7	9.7	10

IR28MW300F			
Analyte	PAL	March 2022	Sept 2022
Benzene	0.5	--	0.55

IR28MW941F			
Analyte	PAL	March 2022	Sept 2022
1,4-Dichlorobenzene	2.1	19	18
Benzene	0.5	3.2	3
Trichloroethene	2.9	28	21
Vinyl Chloride	0.5	49	77

LEGEND

- IR26MW51A — Monitoring Well exceeding remediation goals
- IR26MW71A — BGMP Monitoring Well
- IR26MW43A — Other Monitoring Well (Not Sampled)
- Roads

Parcels

- C
- F (Water)
- UC-2
- Buildings
- Non - Navy Property
- Approximate Area of Groundwater COC Plume that exceed RGs
- Approximate Area of Groundwater COC Plume that exceed ATCs
- Aerobic ISB Treatment
- Anaerobic ISB Treatment Area
- ZVI / Anaerobic ISB Treatment
- ZVI Treatment Area

GRAPHIC SCALE
0 125 FEET

NOTE:
All units in micrograms per liter - µg/L
BGMP - Basewide Groundwater Monitoring Program
PAL - Project Action Level
NS – not sampled by BGMP, monitoring well sampled by remedial action contractor
RU - Remedial Unit
µg/L - Micrograms per Liter
VOCs - Volatile Organic Compounds

Source: Navy, 2023. Final Fall 2021 Semiannual Remedial Action Monitoring Report for Parcel C, Remedial Units C1, C2, C4, and C5. Prepared by Indus General Inc. in association with Insight EEC Inc. and CDM Smith.

Source:
TRBW. 2023. *2022 Basewide Annual Groundwater Monitoring Report, Hunters Point Naval Shipyard, San Francisco, California.* December 2023. FINAL

Figure 4-5
March and September 2022 Exceedances of Remediation Goals in Parcel C Remedial Unit C-2
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Hunters Point Naval Shipyard
San Francisco, California

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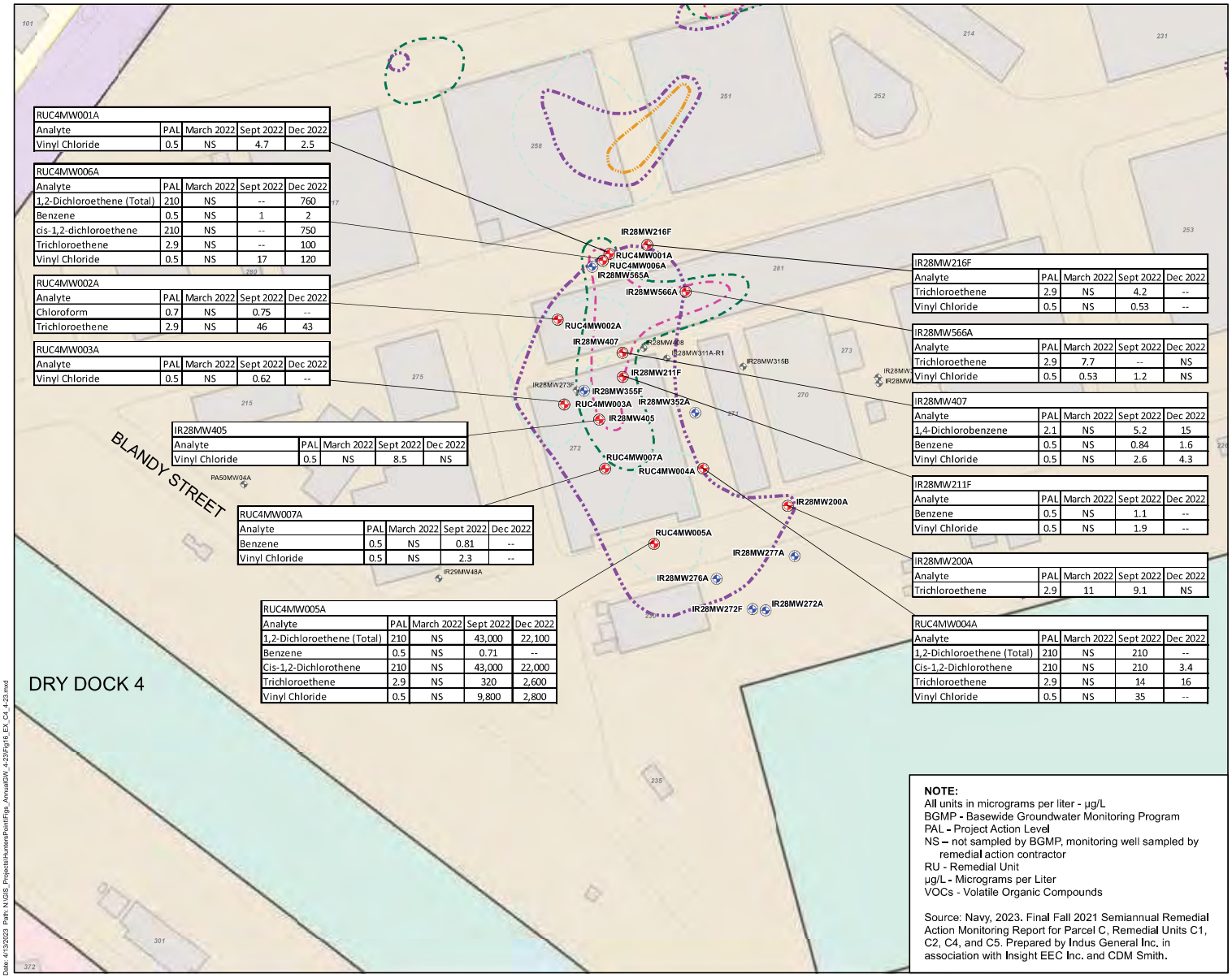

RUC4MW001A				
Analyte	PAL	March 2022	Sept 2022	Dec 2022
Vinyl Chloride	0.5	NS	4.7	2.5

RUC4MW006A				
Analyte	PAL	March 2022	Sept 2022	Dec 2022
1,2-Dichloroethene (Total)	210	NS	--	760
Benzene	0.5	NS	1	2
cis-1,2-dichloroethene	210	NS	--	750
Trichloroethene	2.9	NS	--	100
Vinyl Chloride	0.5	NS	17	120

RUC4MW002A				
Analyte	PAL	March 2022	Sept 2022	Dec 2022
Chloroform	0.7	NS	0.75	--
Trichloroethene	2.9	NS	46	43

RUC4MW003A				
Analyte	PAL	March 2022	Sept 2022	Dec 2022
Vinyl Chloride	0.5	NS	0.62	--

IR28MW405				
Analyte	PAL	March 2022	Sept 2022	Dec 2022
Vinyl Chloride	0.5	NS	8.5	NS

RUC4MW007A				
Analyte	PAL	March 2022	Sept 2022	Dec 2022
Benzene	0.5	NS	0.81	--
Vinyl Chloride	0.5	NS	2.3	--

RUC4MW005A				
Analyte	PAL	March 2022	Sept 2022	Dec 2022
1,2-Dichloroethene (Total)	210	NS	43,000	22,100
Benzene	0.5	NS	0.71	--
Cis-1,2-Dichlorothene	210	NS	43,000	22,000
Trichloroethene	2.9	NS	320	2,600
Vinyl Chloride	0.5	NS	9,800	2,800

IR28MW216F				
Analyte	PAL	March 2022	Sept 2022	Dec 2022
Trichloroethene	2.9	NS	4.2	--
Vinyl Chloride	0.5	NS	0.53	--

IR28MW566A				
Analyte	PAL	March 2022	Sept 2022	Dec 2022
Trichloroethene	2.9	7.7	--	NS
Vinyl Chloride	0.5	0.53	1.2	NS

IR28MW407				
Analyte	PAL	March 2022	Sept 2022	Dec 2022
1,4-Dichlorobenzene	2.1	NS	5.2	15
Benzene	0.5	NS	0.84	1.6
Vinyl Chloride	0.5	NS	2.6	4.3

IR28MW211F				
Analyte	PAL	March 2022	Sept 2022	Dec 2022
Benzene	0.5	NS	1.1	--
Vinyl Chloride	0.5	NS	1.9	--

IR28MW200A				
Analyte	PAL	March 2022	Sept 2022	Dec 2022
Trichloroethene	2.9	11	9.1	NS

RUC4MW004A				
Analyte	PAL	March 2022	Sept 2022	Dec 2022
1,2-Dichloroethene (Total)	210	NS	210	--
Cis-1,2-Dichlorothene	210	NS	210	3.4
Trichloroethene	2.9	NS	14	16
Vinyl Chloride	0.5	NS	35	--

LEGEND

- IR26MW51A — Monitoring Well exceeding remediation goals
- IR26MW71A — BGMP Monitoring Well
- IR26MW43A — Other Monitoring Well (Not Sampled)
- Roads

Parcels

- C
- F (Water)
- UC-2
- Buildings
- Non - Navy Property
- Approximate Area of Groundwater COC Plume that exceed RGs
- Approximate Area of Groundwater COC Plume that exceed ATCs
- Aerobic ISB Treatment
- Anaerobic ISB Treatment Area
- ZVI / Anaerobic ISB Treatment
- ZVI Treatment Area

GRAPHIC SCALE
0 125 FEET

NOTE:
All units in micrograms per liter - µg/L
BGMP - Basewide Groundwater Monitoring Program
PAL - Project Action Level
NS – not sampled by BGMP, monitoring well sampled by remedial action contractor
RU - Remedial Unit
µg/L - Micrograms per Liter
VOCs - Volatile Organic Compounds

Source: Navy, 2023. Final Fall 2021 Semiannual Remedial Action Monitoring Report for Parcel C, Remedial Units C1, C2, C4, and C5. Prepared by Indus General Inc. in association with Insight EEC Inc. and CDM Smith.

Source:
TRBW. 2023. *2022 Basewide Annual Groundwater Monitoring Report, Hunters Point Naval Shipyard, San Francisco, California.* December 2023. FINAL

Figure 4-6
March and September 2022 Exceedances of Remediation Goals in Parcel C Remedial Units C-4
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Hunters Point Naval Shipyard
San Francisco, California

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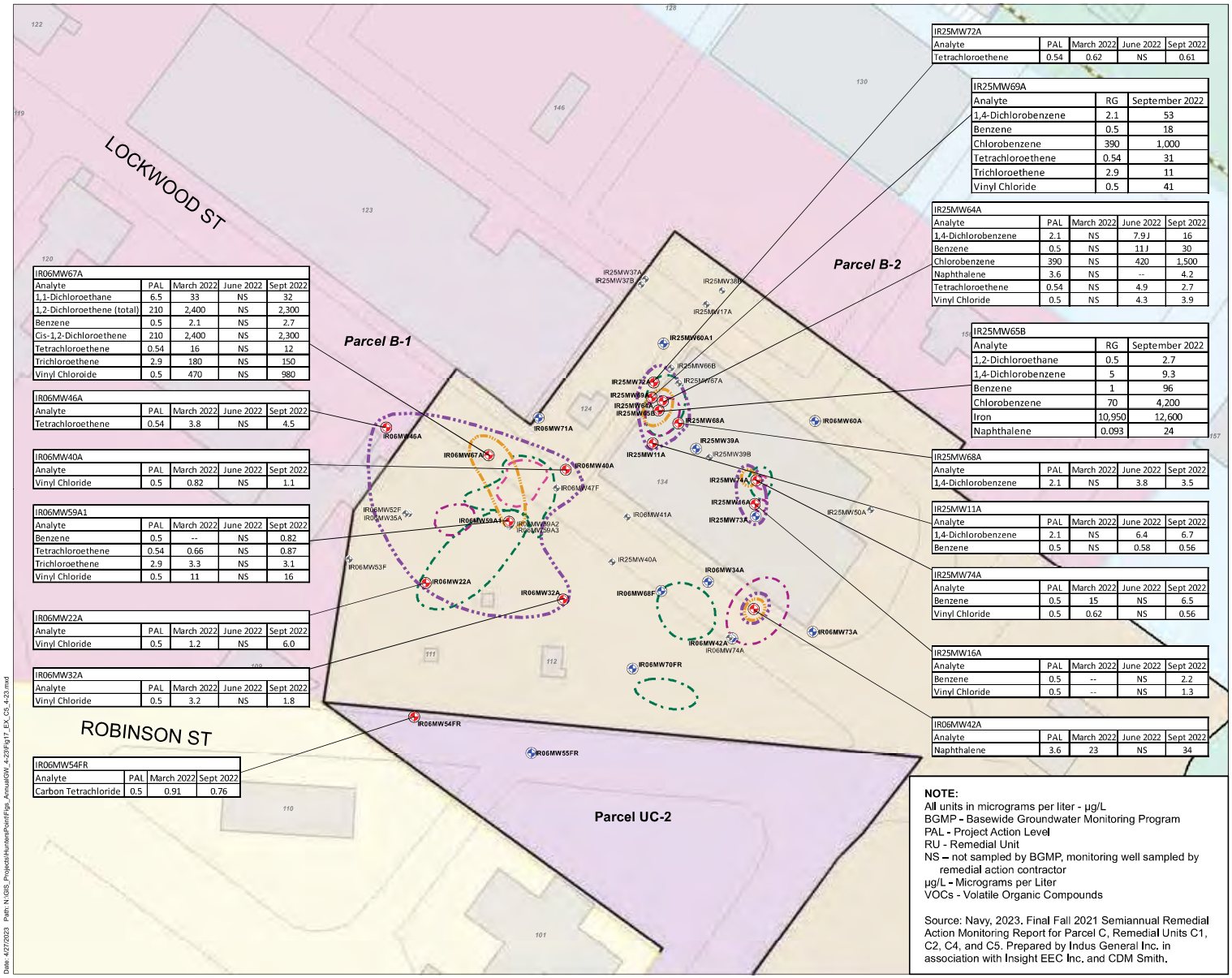


IR06MW67A				
Analyte	PAL	March 2022	June 2022	Sept 2022
1,1-Dichloroethane	6.5	33	NS	32
1,2-Dichloroethene (total)	210	2,400	NS	2,300
Benzene	0.5	2.1	NS	2.7
Cis-1,2-Dichloroethene	210	2,400	NS	2,300
Tetrachloroethene	0.54	16	NS	12
Trichloroethene	2.9	180	NS	150
Vinyl Chloroide	0.5	470	NS	980

IR06MW46A				
Analyte	PAL	March 2022	June 2022	Sept 2022
Tetrachloroethene	0.54	3.8	NS	4.5

IR06MW40A				
Analyte	PAL	March 2022	June 2022	Sept 2022
Vinyl Chloride	0.5	0.82	NS	1.1

IR06MW59A1				
Analyte	PAL	March 2022	June 2022	Sept 2022
Benzene	0.5	--	NS	0.82
Tetrachloroethene	0.54	0.66	NS	0.87
Trichloroethene	2.9	3.3	NS	3.1
Vinyl Chloride	0.5	11	NS	16

IR06MW22A				
Analyte	PAL	March 2022	June 2022	Sept 2022
Vinyl Chloride	0.5	1.2	NS	6.0

IR06MW32A				
Analyte	PAL	March 2022	June 2022	Sept 2022
Vinyl Chloride	0.5	3.2	NS	1.8

IR06MW54FR			
Analyte	PAL	March 2022	Sept 2022
Carbon Tetrachloride	0.5	0.91	0.76

IR25MW72A				
Analyte	PAL	March 2022	June 2022	Sept 2022
Tetrachloroethene	0.54	0.62	NS	0.61

IR25MW69A		
Analyte	RG	September 2022
1,4-Dichlorobenzene	2.1	53
Benzene	0.5	18
Chlorobenzene	390	1,000
Tetrachloroethene	0.54	31
Trichloroethene	2.9	11
Vinyl Chloride	0.5	41

IR25MW64A				
Analyte	PAL	March 2022	June 2022	Sept 2022
1,4-Dichlorobenzene	2.1	NS	7.9 J	16
Benzene	0.5	NS	11 J	30
Chlorobenzene	390	NS	420	1,500
Naphthalene	3.6	NS	--	4.2
Tetrachloroethene	0.54	NS	4.9	2.7
Vinyl Chloride	0.5	NS	4.3	3.9

IR25MW65B		
Analyte	RG	September 2022
1,2-Dichloroethane	0.5	2.7
1,4-Dichlorobenzene	5	9.3
Benzene	1	96
Chlorobenzene	70	4,200
Iron	10,950	12,600
Naphthalene	0.093	24

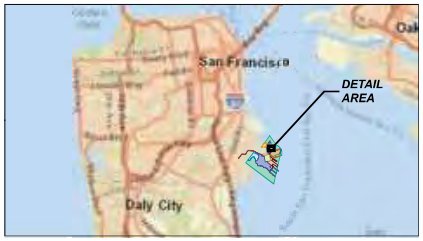
IR25MW68A				
Analyte	PAL	March 2022	June 2022	Sept 2022
1,4-Dichlorobenzene	2.1	NS	3.8	3.5

IR25MW11A				
Analyte	PAL	March 2022	June 2022	Sept 2022
1,4-Dichlorobenzene	2.1	NS	6.4	6.7
Benzene	0.5	NS	0.58	0.56

IR25MW74A				
Analyte	PAL	March 2022	June 2022	Sept 2022
Benzene	0.5	15	NS	6.5
Vinyl Chloride	0.5	0.62	NS	0.56

IR25MW16A				
Analyte	PAL	March 2022	June 2022	Sept 2022
Benzene	0.5	--	NS	2.2
Vinyl Chloride	0.5	--	NS	1.3

IR06MW42A				
Analyte	PAL	March 2022	June 2022	Sept 2022
Naphthalene	3.6	23	NS	34



LEGEND

- IR26MW51A — Monitoring Well exceeding remediation goals
- IR26MW71A — BGMP Monitoring Well
- IR26MW43A — Other Monitoring Well (Not Sampled)
- Roads
- Parcel B seawall

Parcels

B-1, C, F (Water), B-2, UC-2, F (Pier), Non - Navy Property, Buildings

- Approximate Area of Groundwater COC Plume that exceed RGs
- Approximate Area of Groundwater COC Plume that exceed ATCs
- Aerobic ISB Treatment
- Anaerobic ISB Treatment Area
- ZVI / Anaerobic ISB Treatment
- ZVI Treatment Area

GRAPHIC SCALE
N
0
100 FEET

NOTE:
All units in micrograms per liter - µg/L
BGMP - Basewide Groundwater Monitoring Program
PAL - Project Action Level
RU - Remedial Unit
NS – not sampled by BGMP, monitoring well sampled by remedial action contractor
µg/L - Micrograms per Liter
VOCs - Volatile Organic Compounds

Source: Navy, 2023. Final Fall 2021 Semiannual Remedial Action Monitoring Report for Parcel C, Remedial Units C1, C2, C4, and C5. Prepared by Indus General Inc. in association with Insight EEC Inc. and CDM Smith.

Source:
TRBW. 2023. *2022 Basewide Annual Groundwater Monitoring Report, Hunters Point Naval Shipyard, San Francisco, California.* December 2023. FINAL

Figure 4-7
March and September 2022 Exceedances of Remediation Goals in Parcel C Remedial Unit C-5 and Parcel UC-2
Fifth Five-Year Review Report
Hunters Point Naval Shipyard
San Francisco, California

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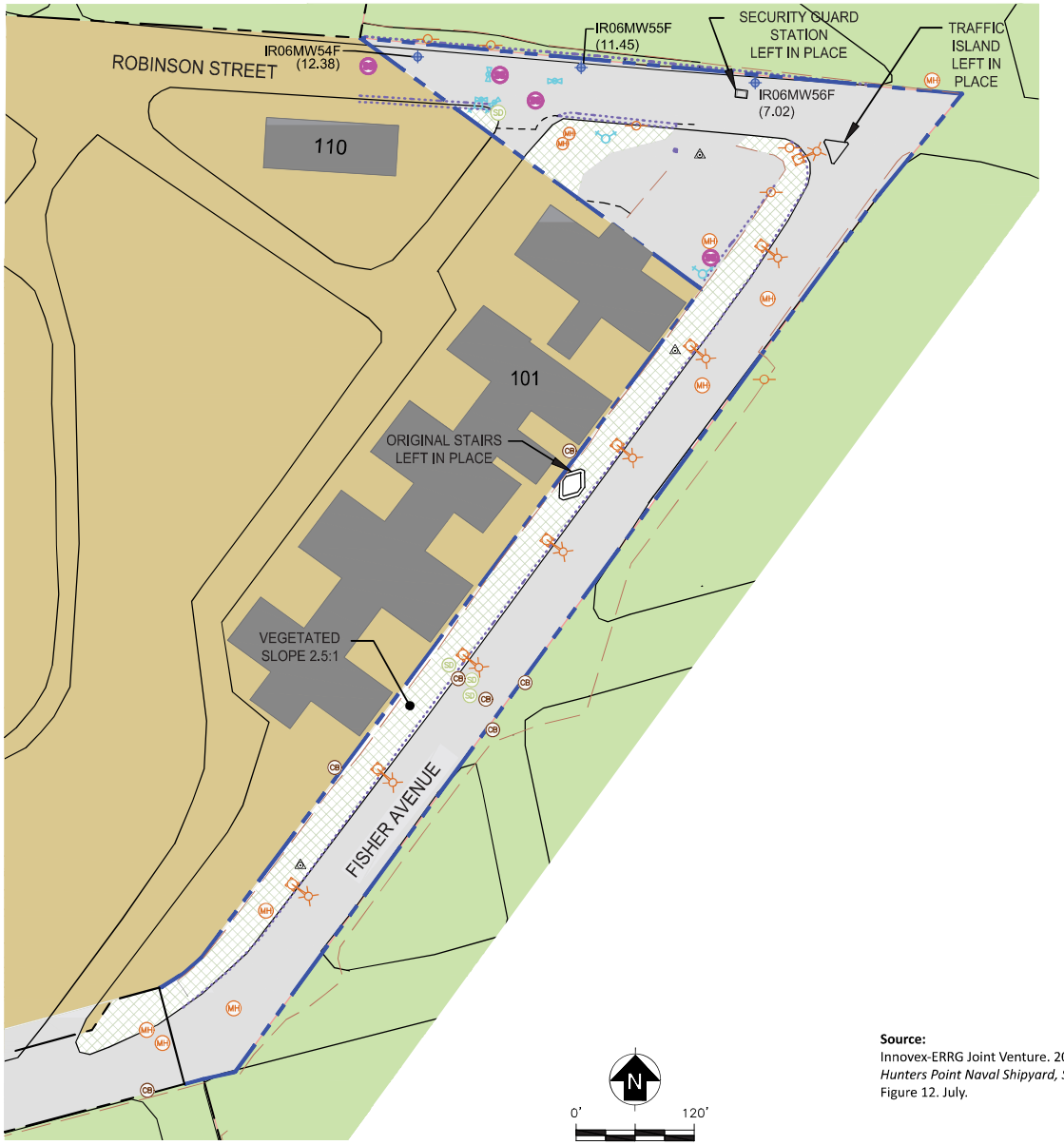

Source:
Innovex-ERRG Joint Venture. 2019. *Fourth Five-Year Review, Hunters Point Naval Shipyard, San Francisco, California.* Figure 12. July.

Figure 4-8
Overview of Remedy Components for Parcel UC-2
Fifth Five-Year Review Report
Hunters Point Naval Shipyard
San Francisco, California

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5.0 Former Parcel D (Parcels D-1, D-2, UC-1, and G)

5.1 Site History and Background

Former Parcel D was formerly part of the industrial support area and was used for shipping, ship repair, and office and commercial activities. Portions of the parcel were used by NRDL (Navy, 2009a).

Former Parcel D is located in the central portion of HPNS and is bordered by Former Parcel C to the northeast, Parcel A to the north/northwest, Parcel E to the west/southwest and the San Francisco Bay to the east. Former Parcel D covered approximately 98 acres which has been subdivided into Parcel D-1 (48.7 acres), Parcel D-2 (5 acres), Parcel UC-1 (3.6 acres), and Parcel G (40 acres) (**Figure 5-1**).

The following IR sites are located in Former Parcel D:

- Parcel D-1: IR-16, IR-17, IR-22, IR-32, IR-35, IR-48, IR-53, IR-55, IR-68, IR-69, and IR-70
- Parcel D-2: none
- Parcel UC-1: none
- Parcel G: IR-09, IR-33, IR-34, IR-37, IR-44, IR-65, IR-66, IR-67, and IR-71

IR-09, the former Pickling and Plate Yard was identified as a source of chromium VI and possibly nickel in groundwater. IR-71 was identified as a solvent plume area. Investigations and actions at Parcel D began in 1988, as shown in the following chronology:

Parcel D Chronology	
Date	**Investigation/Action**
1988–1997	RI
1989	PCB-Contaminated Soil Removal at IR-08
1991-1993	UST and Aboveground Storage Tank Removal
1994	SI for Parcels B, C, D, and E
1991-1995	Basewide removal of sandblast waste
1994-1996	Contaminated equipment and residue removal – IR-09
1996	Removal of Cesium-Impacted Soil (Building 364)
1996–1997	Exploratory Excavation Removal Action
1996–1997	Removal of Storm Drain Sediment
1996–1997	FS
2001	TCRA for Non-VOCs in Soil
2001-2002	Radiological TCRA
2002	Groundwater Data Gaps Investigation
2002–2003	Waste Consolidation and Removal Activities
2003–2004	Soil Stockpile Removal Action
2004	HRA

Parcel D Chronology	
Date	**Investigation/Action**
2004-ongoing	Groundwater Monitoring under BGMP
2006–2011	Storm Drain and Sanitary Sewer Removal Actions
2007	Revised FS
2008-2009	Treatability Study for Groundwater at Parcels D-1 and G
2/2009	ROD for Parcel G
7/2009	ROD for Parcels D-1 and UC-1
8/2010	NFA ROD for Parcel D-2
2010-2011	Soil excavation and removal Parcel G
2010-2013	Soil Excavation and Removal at Parcel D-1 Phase I Radiological TCRA for Parcel D-1
2011	RACR for Soil Hotspot Removal at Parcel D and G
2012	Durable Cover Installation Parcel UC-1
2012-2013	Durable Cover Installation Parcel G
2013	Third Five-Year Review for HPNS RACR for Durable Covers and Groundwater Remediation in Parcel UC-1
2014	RACR for Durable Covers in Parcel G
2014-2017	Phase II Radiological TCRA for Parcel D-1
2015	Parcel UC-1 Transferred to OCII
2016-2018	Durable Cover Installation at Parcel D-1
4/2017	ESD to the Final ROD for Parcel G
2018	RACR for Durable Cover in Phase I area of Parcel D-1
2019	Fourth Five-Year Review for HPNS
2022-ongoing	Radiological Retesting in Parcel G
2023	Focused FS Parcel D-1

5.2 Site Characterization

This section summarizes the findings from various investigations at Former Parcel D that are pertinent to the Five-Year Review.

5.2.1 Physical Characteristics

5.2.1.1 Surface Features

Former Parcel D is located in the lowlands portion of HPNS and ground surface elevations range between 0 and 10 feet above msl. The majority (approximately 85 percent) of the surface

is covered with pavement and former industrial buildings. Surface water runoff was historically collected in the storm drain system and discharged to the bay through outfalls; however, the storm drains and sewer lines were removed during radiological investigations and stormwater is redirected to San Francisco Bay via surface drainage swales.

5.2.1.2 Geology and Hydrogeology

The majority of the parcel consists of lowlands that were filled by placing borrowed fill material from various sources, including crushed serpentinite bedrock from the adjacent highland, construction debris, and waste materials (such as used sandblast materials). The serpentinite bedrock and serpentine bedrock-derived fill material consist of minerals that naturally contain asbestos and relatively high concentrations of arsenic, manganese, nickel, and other ubiquitous metals.

The following is a summary of hydrostratigraphic units at Former Parcel D (SulTech, 2007):

- **A-Aquifer**: The A-aquifer is present throughout Former Parcel D. Groundwater flow is complex because it is affected by a groundwater sink located near the former boundary of Parcel D (currently in Parcel E), a groundwater mound in Parcel E, leaks of groundwater into former sanitary sewers, recharge from water supply lines, and tides in the bay. Most groundwater flows toward the bay except in the western portion of Parcel D which flows away from the mound and toward the sink in Parcel E. The A-aquifer averages between 10 and 40 feet thick with an average thickness of 25 feet over most of Former Parcel D. Tidal fluctuations were observed from 150 to 500 feet inland from the bay.
- **Bay Mud**: The Bay Mud is absent in the northern part of Former Parcel D (Parcels D-2, UC-1, and G) where the A-aquifer is in direct communication with the bedrock aquifer. It is thickest in the southeastern part of the parcel (Parcel D-1).
- **B-Aquifer**: The B-aquifer consists of small laterally discontinuous permeable sediment lenses of gravel, sand, silty sand, or clayey sand intermingled with aquitard. The largest B-aquifer area is present near the center of the parcel (Parcel G) and is approximately 1,500 feet wide, 1,000 feet long and 20 to 30 feet thick. It is not present in Parcel D-2 and UC-1. Groundwater elevations range from 0 to 2 feet above msl through the majority of Parcel D-1 and the eastern portion of Parcel G, to an elevation of 3 to 4 feet above msl in the western portion of Parcel G (TRBW, 2023). Groundwater flow is generally to the southeast.

As discussed in **Section 1.3.4.3**, the entire A-aquifer meets the Resolution 88-63 exception criteria. Although it does not meet the Resolution 88-63 exception criteria, the B-aquifer has a low potential for drinking water use.

5.2.2 Land Use

5.2.2.1 Current Land Use

Parcels D-1 and G are currently owned by the federal government under the jurisdiction of the Navy. There are no tenants at Parcels D-1 and G.

Parcels D-2 and UC-1 were transferred out of federal ownership to the OCII in late 2015. Redevelopment activities were temporarily suspended pending completion of the corrective actions related to the radiological remediation. In the interim, access restrictions are in place to limit exposure of property users to hazardous substances.

5.2.2.2 Future Land Use

According to the Redevelopment Plan (OCII, 2018), Parcel D-1 land use will predominantly include parks and open space; however, land use in the northern portion of the parcel will be identical to Parcels D-2, G, and UC-1. Land use at Parcels D-2, G, and UC-1 will include office and industrial, hotel, infrastructure/utility, multi-media and digital arts, institutional, civic, arts and entertainment, residential, parks and recreation uses (if not subject to applicable environmental restrictions).

5.2.3 Basis for Taking Action

This section describes the results of site investigations and risk assessments that provide the basis for taking action at Parcel D. Details are provided in the RI (PRC et al., 1996), FS (SulTech, 2007), Parcels D-1 and UC-1 ROD (Navy, 2009a), Parcel G ROD (Navy, 2009b) and Parcel D-2 ROD (Navy, 2010).

5.2.3.1 Site Investigations and Pre-ROD Removal Actions

Previous investigations at Former Parcel D identified metals and PAHs in soil (Parcels D-1, UC-1, and G), metals and VOCs in groundwater (Parcels D-1 and G), and radiologically impacted structures and soil (Parcels D-1, D-2, UC-1, and G).

Several removal actions have occurred throughout Former Parcel D including underground storage tank removals, sandblast grit removal, storm drain sediment removal, and a TCRA to remove contaminated soil from IR-09, IR-37, and IR-65 within Parcel G. Contamination in soil and groundwater remained after these removal actions (Navy, 2009a, 2009b).

A groundwater treatability study was conducted prior to the RODs using ZVI to address VOCs in two plumes (identified as IR-71 West and IR-71 East) originating in Parcel G and extending into Parcel D-1. Approximately 136,000 pounds of ZVI was injected into 88 groundwater injection points in the IR-71 West plume between October and December 2008. A post-injection groundwater and soil vapor assessment was conducted between December 2008 and April 2009 to verify the effectiveness of the ZVI treatment. The treatability study concluded the IR-71 West plume required treatment with ZVI to address chloroform in groundwater and the IR-71 East plume did not require treatment to address VOCs in groundwater (Alliance, 2010).

5.2.3.2 Human Health Risk

A quantitative HHRA was completed for Parcel D as part of the RI (PRC et al., 1996), updated in the 2002 draft revised FS for Parcel D, and updated again in the 2007 Revised FS (SulTech, 2007) to account for the soil data collected during the 2004 TCRA, and to incorporate changes in regulatory guidance and toxicological criteria that occurred since the previous HHRAs. Human health risks were characterized separately for COCs and ROCs. The following unacceptable human health risks from nonradiological chemicals were identified in the ROD for Parcels D-1, UC-1 and/or G (**Table 5-1**):

- Future industrial users from exposure to metals in surface soil (0 to 2 feet bgs) and subsurface soil (0 to 10 feet bgs), and VOCs in groundwater (in A-aquifer beneath Parcels D-1 and G through the vapor intrusion to indoor air pathway).
- Future recreational users from exposure to metals and PAHs in surface soil (0 to 2 feet bgs).
- Future residents (adult and child) from exposure to metals and PAHs in surface soil (0 to 2 feet bgs) and subsurface soil (0 to 10 feet bgs) and VOCs in groundwater (A-aquifer

beneath Parcels D-1 and G through the vapor intrusion to indoor air pathway and B-aquifer through domestic use).

- Future construction workers from exposure to metals and PAHs in subsurface soil (0 to 10 feet bgs) and VOCs and metals in A-aquifer groundwater via inhalation and through direct exposure in trenches.

There were no potential unacceptable human health risks associated with nonradiological chemicals for Parcel D-2 and no RA is required for nonradiological chemicals.

Additionally, ROCs within impacted buildings, storm drains, sanitary sewers, and associated soil were identified at Parcels D-1, D-2, UC-1, and G (**Table 5-2**) (TtEC, 2008).

5.2.3.3 Ecological Risk

The Navy concluded that limited viable habitat is available for terrestrial wildlife at Former Parcel D because most of the site is covered with pavement and most of the terrestrial component of the shoreline at Parcel D is paved (PRC et al., 1996). The tidal area associated with the shoreline is associated with Parcel F. Therefore, ecological risk associated with exposure to soil was not evaluated further.

The Navy completed a screening evaluation of surface water quality to assess potential exposure by aquatic wildlife to groundwater as it interacts with the surface water of San Francisco Bay. Results of the screening evaluation indicated two metals (chromium VI and nickel) in groundwater may pose a potential risk to aquatic wildlife. However, groundwater monitoring data indicate metals migrate at a much slower rate than groundwater flows; thus, discharge of metals to the bay is not imminent. COECs and TLs are presented in **Table 5-1.**

No COECs were identified in the B-aquifer.

5.3 Remedial Action Objectives

The ROD for Parcels D-1 and UC-1 was signed on July 24, 2009 (Navy, 2009b). **Table 5-3** summarizes the basis for action, RAOs, remedy components, performance metrics, and expected outcomes for Parcels D-1 and UC-1.

The ROD for Parcel G was signed on February 18, 2009 (Navy, 2009a) and the ESD was signed on April 19, 2017 (Navy, 2017). **Table 5-4** summarizes the basis for action, RAOs, remedy components, performance metrics, and expected outcomes for Parcel G. The presence of VOCs in groundwater and soil may contribute to the presence of VOC in soil gas, therefore the vapor intrusion pathway is included as a basis for action and development of RAOs.

The Navy developed RGs to meet the RAOs for soil, sediment, and RGs and TLs for groundwater which are summarized for COCs (or COECs) in **Table 5-1** and for ROCs in **Table 5-2.** The TLs are conservative, and exceedance of a TL does not necessarily indicate an immediate risk, given dilution and mixing with surface water; nonetheless a potential for ecological risk was identified if the metals in groundwater discharge undiluted to the bay.

The No Further Action ROD for Parcel D-2 was signed on August 9, 2010 (Navy, 2010).

5.4 Remedial Actions

5.4.1 Parcel D-1

The RA for Parcel D-1 includes the following major components:

- Soil excavation and removal to address COCs in soil
- Durable cover installation and maintenance to address COCs in soil
- In situ treatment for VOCs and metals in groundwater
- LTM of groundwater for COCs
- Radiological surveys and remediation through removal of all radiologically impacted soil and through decontamination (and demolition/dismantling if necessary) buildings, structures, and former building sites
- ICs for soil and groundwater

Remedy components are shown on **Figures 5-1** and **5-2.**

5.4.1.1 Remedy Implementation

Soil Excavation and Removal

Excavation and removal of soil containing COCs above RGs was conducted from 2010 to 2011 and in a second phase in 2013. In total, approximately 237 loose cubic yards of soil was excavated from six hotspot areas in Parcel D-1 to address PAH contamination in soil. Four of the hotspot areas were removed during the first phase of the RA conducted between August 2010 and May 2011. The two remaining hotspot areas were removed during the second phase of the RA conducted between May 2013 and July 2013, when the radiological screening yard was inactive. All excavated soil was disposed of offsite and the excavations were backfilled with clean imported soil (ERRG, 2011 and 2014). One soil stockpile, totaling 75 cubic yards, identified in the RD was also removed and disposed of offsite. Completion of construction activities is documented in the *RACR for Soil Hotspot Locations at Parcels B, D-1, and G* (ERRG, 2011).

Durable Cover Installation

Durable covers consist of seawall stabilization, asphalt concrete durable covers, and building foundations. Durable covers were installed in two phases at Parcel D-1. Phase I was conducted from May 2016 to February 2017 (APTIM, 2018, **Figure 5-3**) and Phase II was conducted from August to November 2018 (APTIM, 2021). Completion of the durable covers along with ICs discussed in **Section 1.3.4.2** meets the RAOs for soil at Parcel D-1. Response complete for the Phase I area soil is documented in the RACR for Parcel D-1, Phase I (APTIM, 2018). The RACR for Phase II is pending completion of a Focused FS to address radioactive objects that were identified during construction of the cover (discussed in **Radiological Surveys and Remediation** below).

- **Seawall Stabilization**. Repairs to the subgrade were made behind the Parcel D-1 seawalls along portions of the piers to provide a stable vertical surface for attaching the durable cover. Where necessary, granular fill or, where greater than 18 inches was needed, gabion baskets were used to restore the area behind the seawall to meet surrounding grade. A layer of geotextile was emplaced to minimize fine soil from entering the bay and prevent soil from "piping" through the riprap, and riprap was placed over the fabric. Along Berth 15 of the Gun Mole Pier, an approximately 40-foot long segment of seawall was heavily corroded and gabion baskets were installed along the interior sheet pile wall rather than the outer seawall. The durable cover was installed to the edge of the gabion basket and a fence and entry gate were installed surrounding the area to prevent access.

- **Asphalt Cover**. New asphalt cover was installed over portions of the site that did not have an existing asphalt cover. Low-lying areas were filled with clean fill and a minimum 4-inch thick layer of recycled aggregate base course was emplaced with a minimum 2-inches of asphaltic concrete wear surface. Areas with existing asphalt cover were repaired either by removing and replacing the cover or by repairing where cracks were between ¼ to ¾ inches wide by hot-pouring crack sealant.
- **Building foundation repairs**. Eleven buildings are located within Parcel D-1: Buildings 274, 306, 307, 308, 368, 369 381, 523, 525, 526, and 530. Where needed, building foundation repairs were completed by using a variety of materials such as concrete, non-shrink grout, and asphaltic concrete, to prevent access to underlying soil. Building foundations that could not be restored or repaired (for example, historical buildings) were secured using a combination of steel plates, framed plywood walls, wire mesh, and/or chain-link fence to prevent access. Access to soil under buildings through crawlspaces and vaults was blocked with durable wire mesh or secured with steel ties. A transformer was found inside of Building 369 and testing indicated that the oil did not contain PCBs so it was recycled (APTIM, 2018). Asbestos tile was identified in Buildings 526 and 530, which was removed and disposed of by a California-licensed asbestos abatement contractor (APTIM, 2021).

In Situ Groundwater Remediation

The active treatment portion of the IR-71 plume was conducted within Parcel G and is discussed in **Section 5.4.4**. There were no active groundwater treatment activities conducted within the boundary of Parcel D-1.

Groundwater Monitoring

Groundwater monitoring is conducted under the BGMP to evaluate COCs concentration trends. VOC analysis was discontinued in 2012 since concentrations were below the RG and were stable and declining (Navy, 2012). Annual and semiannual groundwater monitoring reports from 2019 through 2022 were reviewed (TRBW, 2020a, 2020b, 2021, 2022a, 2022b, 2023). Three monitoring wells are currently sampled semiannually for metals. There were no exceedances of the TLs during any of the sampling events (**Appendix E**). Concentrations of metals have remained under RGs and TLs since 2004 with the exception of silver in July 2008 and lead in September 2015 in 1 monitoring well.

The Parcel D-1 RAMP (ChaduxTt, 2011a) states that groundwater samples will be collected semiannually until at least two years after property redevelopment to ensure redevelopment activities do not mobilize metals that could migrate into the bay.

Radiological Surveys and Remediation

The TCRA for radiologically impacted soil and structures at Parcel D-1 was completed in two phases. Phase I addressed the northern portion of Parcel D-1 and was initiated in 2009 and completed in 2013 (Shaw, 2014). The second phase was initiated in 2013 and completed in 2017. During Phase II excavation work, low-level radiological objects (ROs) were discovered in areas that were not considered radiologically impacted. The Navy determined that these objects were within the fill soil used to expand the shipyard after 1946. Based on the post-removal sampling completed during both phases, all radiologically impacted soil and structures identified in the HRA were removed. Additionally, there is a high degree of confidence that discrete ROs were removed to a depth of 2 feet bgs. However, there is a potential for ROs to be present in material below 2 feet bgs where shoreline expansion has occurred since 1946 (Gilbane, 2019).

The ROD anticipated that the TCRA for radiologically impacted structures would result in unrestricted radiological release of Parcel D-1. However, due to the potential for radiological items to be present in fill, unrestricted radiological release could not be achieved for Parcel D-1. Land use and activity restrictions are currently in place to prohibit land-disturbing activities throughout Parcel D-1 until the remedy is amended to mitigate risk to human health relating to the potential presence of ROs in material below 2 feet. The Focused FS to evaluate additional remedies to address radiologically impacted soil at was finalized in 2023 (Innovex-ERRG Joint Venture, 2023) and the Proposed Plan and Amended ROD is pending.

Institutional Controls

The entire area of Parcel D-1 (48.7 acres) is subject to soil and groundwater ICs. A portion of Parcel D-1 is also subject to ICs for VOCs; however, the extent is currently under evaluation as discussed in the following paragraph. IC performance objectives were developed and presented in the ROD (Navy, 2009b) and LUC RD (ChaduxTt, 2011b). The IC performance objectives to be implemented through land use restrictions for the site are summarized in **Table 1-3.**

Vapor intrusion ARICs are based on a soil gas survey completed in 2010 (Sealaska Environmental Services, 2013). As requested by USEPA, the Fourth Five-Year Review evaluated the SGALs and ARICs boundary for VOCs in soil gas based on a grid overlay and risk screening estimates/ grid block. One block was identified for additional investigation due to the noncancer hazard index exceeding 1.0. Current and future exposures are being controlled under Navy ownership; however, this additional block may warrant further evaluation prior to Navy transfer of this parcel (APTIM, 2021).

5.4.1.2 Remedy Operations and Maintenance

Ongoing O&M at Parcel D-1 includes maintaining the integrity of the durable covers and IC inspections. The inspection and maintenance requirements for the durable covers are described in the Final O&M Plan for Parcel D-1 (APTIM, 2018, 2019). AOMSRs are prepared to summarize inspections and maintenance performed and to document the effectiveness of the remedy components. AOMSRs from 2019, 2020, 2021, and 2022 were reviewed (Innovex-ERRG Joint Venture, 2020, 2021; APTIM, 2022, 2023).

Durable Cover Maintenance

The shoreline armoring was found to be in good condition with the exception of the north side of Gun Mole Pier during the 2021 inspection, which showed signs of rock movement, but the integrity of the riprap was not compromised and was still functioning.

Overall, the durable covers were in good repair with the exception of several cracks and subsidence areas on Gun Mole Pier. A large subsidence area that could not be repaired was identified during the 2020 inspection. Twelve subsidence areas were identified in 2021, nine of which were repaired, and three were deemed no longer repairable and the area was permanently fenced off to prevent access (APTIM, 2022). The Navy is currently conducting a shoreline assessment study to identify and recommend repairs and/or stabilization of structures and shoreline.

Institutional Controls Compliance

ICs are inspected annually and no deficiencies or inconsistent uses were observed during the reviews. General site conditions were determined to be good. Remedy components such as survey benchmarks and monitoring well vault covers were found to be in good condition.

Navy controls access to the parcel using security fencing, signage, locks, and gates which were found to be in good condition, with no signs of damage or vandalism.

5.4.2 Parcel UC-1

The RA for Parcel UC-1 includes the following major components:

- Durable cover installation and maintenance to address COCs in soil
- Radiological surveys and remediation through soil excavation and removal of sanitary sewer and storm drain lines and through decontamination (and demolition/dismantling if necessary) buildings, structures, and former building sites
- ICs for soil

Remedy components are shown on **Figures 5-1, 5-2,** and **5-4.**

5.4.2.1 Remedy Implementation

Durable Covers

Durable covers were constructed between May 14, 2012 and September 18, 2012. Completion of the durable covers along with ICs as discussed in **Section 1.3.4.2** meets the RAOs for soil in Parcel UC-1; response complete is documented in the RACR for Parcels UC-1 and UC-2 (ERRG, 2013). The RA included installation and repair of durable covers, including soil covers, asphalt covers, and building foundations, to minimize exposure of humans and wildlife to potential COCs in underlying soil. The following is a description of each cover type:

- **Soil Cover**. A 2-foot-thick soil cover comprised of clean imported fill was installed over previously vegetated areas by removing two feet of existing soil so that the surface of the newly installed cover matched historical site grades. Live beach strawberry, California poppy, and summer lupine plants were then hand-planted across the entire soil cover to provide future slope stability and aesthetic appeal.
- **Asphalt Covers**. An 8-inch asphalt cover, comprising 4 inches (minimum) of AC and 4 inches (minimum) of aggregate base, was installed. Existing asphalt covers that were in good condition were left in place and incorporated into the final asphalt pavement cover. Degraded existing asphalt covers were repaired by removing and replacing one or more of the following: asphalt concrete cover, aggregate base, or subbase material, depending the level of degradation. Asphalt concrete covers with minor cracking were repaired by applying an asphalt seal to fill the cracks.
- **Restored Building Foundations**. Concrete building foundations and sidewalks were restored and incorporated into the durable cover and cracks and penetrations were filled with non-shrink grout.

Radiological Surveys and Remediation

ROPCs at Parcel UC-1 include Cs-137, Co-60, Pu-239, Ra-226, Sr-90, Th-232, tritium (hydrogen-3), and uranium-235 (U-235) (Navy, 2009a). The Navy conducted TCRAs at Parcel UC-1 to address potential radioactive contamination in storm drains and sanitary sewer lines at Parcels UC-1 and UC-2 (ChaduxTt, 2010a; TtEC, 2011). In total, approximately 20,680 cubic yards of soil were excavated during removal of approximately 6,407 linear feet of sanitary sewer and storm drain lines. Approximately 1,138 cubic yards of soil was disposed of offsite as

LLRW based on surface scan and analytical laboratory results. Additionally, FSSs were performed at two radiologically impacted buildings (819 and 823) [TtEC, 2011].

The TCRA data was reviewed as described in **Section 1.4.3** and radiological retesting, including sampling and surveys of soils previously investigated during sanitary sewer line storm drain removal and resurvey of impacted buildings and former building sites, is in progress to determine if current site conditions are compliant with the RAOs.

Institutional Controls

The entire area of Parcel UC-1 is subject to soil ICs. The majority of Parcel UC-1 is also subjected to ARICs for VOCs. The IC performance objectives were developed and presented in the ROD (Navy, 2009b) and LUC RD (ChaduxTt, 2010b) and are summarized in **Table 1-3**. The ICs are currently being enforced through a Covenant to Restrict Use of Property recorded on September 16, 2015 (Navy, 2015).

5.4.2.2 Remedy Operations and Maintenance

Ongoing O&M at Parcel UC-1 is the responsibility of the OCII's contractor in accordance with the approved RMP (Geosyntec, 2019) and O&M plan (Navy, 2013). Annual reports from the OCII contractor summarizing durable cover O&M and IC inspections were reviewed (Geosyntec-Albion Joint Association, 2020, 2021, 2022).

Durable Cover Maintenance

Minor settling was observed during the 2021 inspection and evidence of burrowing pests within the soil cover were observed during the 2020 and 2021 inspections. Repairs were conducted in October 2020, December 2021, and January 2022. Vegetation in the soil cover is in good condition. In general, the durable cover was found in good condition with minor crack and pothole repairs completed during O&M.

Land Use Controls Compliance

No deficiencies or inconsistent uses were observed during the review period.

5.4.3 Parcel D-2

An NFA ROD was signed for Parcel D-2 in 2010 after the TCRA remediated all radiological concerns at Parcel D-2 (Navy, 2010). The pre-TCRA ROPCs at Parcel D-2 included Cs-137, Ra-226, Sr-90 (Navy, 2010). The Navy conducted TCRAs from 2004 to 2010 at Parcel D-2 to address potential radioactive contamination in storm drains and sanitary sewer lines and radiologically impacted structures. In total, 1,988 linear feet of trench and 1,434 cubic yards of soil were excavated; approximately 45 cubic yards of soil was disposed of offsite as LLRW based on surface scan and analytical laboratory results (TtEC, 2011a). Additionally, a FSS was performed at one radiologically impacted building (Building 813) (TtEC, 2011a).

The TCRA data was reviewed as described in **Section 1.4.3** and radiological retesting, including sampling and surveys of soils previously investigated during sanitary sewer line storm drain removal and resurvey of impacted buildings and former building sites, is in progress to determine if current site conditions are acceptable for UU/UE.

5.4.4 Parcel G

The RA for Parcel G includes the following major components:

- Soil excavation and removal to address COCs in soil

- Durable cover installation and maintenance to address COCs in soil
- In situ treatment to address COCs in groundwater
- Groundwater monitoring including MNA and LTM to address VOCs and metals in groundwater
- Radiological surveys and remediation through soil excavation and removal of sanitary sewer and storm drain lines and through decontamination (and demolition/dismantling if necessary) buildings, structures, and former building sites
- ICs for soil and groundwater

Remedy components are shown on **Figures 5-1, 5-2,** and **5-5.**

5.4.4.1 Remedy Implementation

Soil Excavation and Removal

In total, approximately 66 loose cubic yards of soil was excavated from two hotspot areas in Parcel G to address PAH and lead contamination in soil between August 2010 and May 2011. All excavated soil was disposed of offsite and the excavations were backfilled with clean imported soil. Two soil stockpile, totaling 20 cubic yards, identified in the RD were also removed and disposed of offsite. Completion of construction activities is documented in the *RACR for Soil Hotspot Locations at Parcels B, D-1, and G* (ERRG, 2011).

Durable Cover Installation

Durable covers at Parcel G consist of asphalt concrete durable covers and building foundations. Work was initiated in June 2012 and was completed in October 2013. Completion of the durable covers along with ICs discussed in **Section 1.3.4.2** meets the RAOs for soil at Parcel G; response complete for soil is documented in the RACR for Parcel G (Arcadis, 2014a).

- **Asphalt Durable Cover**. Existing asphalt concrete in functional and reparable condition were sealed with asphalt crack seal or, in areas with larger cracks, application of additional layers of asphalt concrete over the existing surface. Portions of Parcel G where asphalt pavement was not exposed at the ground surface received new pavement construction. New construction included the reuse of the aggregate base material present at the site and import of new aggregate base material. New pavement was constructed on approximately 66 percent of the exterior ground surface area or about 44 percent of the total parcel area. The overall thickness of the aggregate base was a minimum of 4 inches with a minimum of 2 inches of asphalt concrete wear surface. Pavement restoration and subgrade preparation were conducted in a manner that improves site drainage and directs runoff to the existing swales that run through Parcel G as specified in the Grading, Drainage, and Paving Plan (Arcadis, 2012). This improvement was achieved by establishing proper pavement grades and slopes that allow for positive drainage away from buildings and into the four swales on Parcel G, which run north to south, and limits upland accumulation of stormwater.
- **Building foundation repairs**. Twelve buildings are located within Parcel G: Buildings 302, 324, 351, 363, 366, 401, 402, 404, 407, 411, 415, and 439. Where needed, building foundation repairs were completed by using a variety of materials such as concrete, non-shrink grout, and asphaltic concrete, to prevent access to underlying soil. Building foundations that could not be restored or repaired were secured using a combination of steel plates, framed plywood walls, wire mesh, and/or chain-link fence to prevent access. Access

to soil under buildings through crawlspaces and vaults was blocked with durable wire mesh or secured with steel ties.

The site was secured with temporary K-rail barriers and signs to prevent access.

In Situ Groundwater Treatment

The Navy conducted a treatability study using ZVI at Parcel G in 2008 to evaluate technologies to address VOCs and metals in groundwater beneath IR-09 (North) and IR-71 (Alliance, 2010). Three additional plumes were originally identified for treatment (within IR-33, IR-71 East, and IR-09 South) but treatment was not required based on a soil gas investigation that indicated soil gas levels were acceptable. After the treatability study, concentrations of COCs in groundwater within the treatability study area dropped below the RGs established in the ROD except for groundwater at one well (IR09MW07A) in the deeper portion of the upper A-aquifer. The Navy decided, with the concurrence from the BCT, not to continue to treat the deeper portions of the A-aquifer. The risk related to VOCs in groundwater was based on migration to indoor air from the shallow groundwater, and the study concluded that the associated risk to commercial/industrial workers was less than the target risk threshold and that RAOs are being met. Response complete for groundwater treatment is documented in the RACR for Parcel G (Arcadis, 2014a).

Groundwater Monitoring

Groundwater monitoring is conducted under the BGMP to evaluate COCs concentration trends. Chromium VI sampling was discontinued in 2012 because concentrations were below the TL and were stable or decreasing (Navy, 2012). Annual and semiannual groundwater monitoring reports from 2019 through 2022 were reviewed (TRBW, 2020a, 2020b, 2021, 2022a, 2022b, 2023). Exceedances of the RGs (identified as PALs) from 2019, 2020, 2021, and 2022 are presented in **Appendix E.**

Two monitoring wells are sampled semiannually for VOCs under the BGMP; however, One monitoring well (IR71MW03A) was inaccessible because of the ongoing radiological rework during the 2021 and 2022 events. Chloroform and carbon tetrachloride exceeded the RG in 2022, and PCE has historically exceeded the RG in groundwater from IR71MW03A during one or more sampling events during this Five-Year Review period.

Radiological Surveys and Remediation

The ROPCs at Parcel G include Cs-137, Co-60, Pu-239, Ra-226, Sr-90, Th-232, tritium, and U-235 (Navy, 2009a). The Navy conducted a TCRA at Parcel G to address potential radioactive contamination in storm drains and sanitary sewer lines and radiologically impacted structures. In total, 50,688 cubic yards of soil were excavated during removal of 23,166 linear feet of sanitary sewer and storm drain lines. Approximately 6,228 cubic yards of soil was disposed of offsite as LLRW based on surface scan and analytical laboratory results. Additionally, FSSs were performed at seven radiologically impacted buildings (351, 351A, 366, 401, 408, 411, 439) and one former site (317/364/365) [TtEC, 2011b].

The TCRA data was reviewed as described in **Section 1.4.3** and radiological retesting, including sampling and surveys of soils previously investigated during sanitary sewer line storm drain removal and resurvey of impacted buildings and former building sites, is currently being conducted to determine if current site conditions are compliant with the RAOs.

Institutional Controls

The entire area of Parcel G (49 acres) is subject to soil and groundwater ICs. A portion of Parcel G is also subject to ICs for VOCs (**Figure 5-2**). IC performance objectives were developed and presented in the ROD (Navy, 2009b) and LUC RD (ChaduxTt, 2011b) and were updated in the ESD to remove residential restrictions throughout the majority of the site (Navy, 2017). The IC performance objectives to be implemented through land use restrictions for the site are summarized in **Table 1-3.**

5.4.4.2 Remedy Operations and Maintenance

Ongoing O&M at Parcel G includes maintaining the integrity of the durable covers and IC inspections. The inspection and maintenance requirements for the durable covers are described in the Final O&M Plan for Parcel G (Arcadis, 2014b). AOMSRs are prepared to summarize inspections and maintenance performed and to document the effectiveness of the remedy components. AOMSRs from 2019, 2020, 2021, and 2022 were reviewed (Innovex-ERRG Joint Venture, 2020, 2021; APTIM, 2022, 2023).

Durable Cover Maintenance

In general, the durable covers were in good condition with some minor subsidence around Building 351 that was repaired in 2019. Beginning in 2020, radiological retesting was being conducted which limited site access to perform durable cover inspections; however, the areas that could be inspected were in generally good condition with areas that could easily be repaired. Swales and check dams were in good condition.

Institutional Controls Compliance

ICs are inspected annually and no deficiencies or inconsistent uses were observed during the reviews. General site conditions were determined to be good. Remedy components such as survey benchmarks and monitoring well vault covers were found to be in good condition.

Navy controls access to the parcel using security fencing, signage, locks, and gates which were found to be in good condition, with no signs of damage or vandalism.

5.4.5 Progress Since the Fourth Five-Year Review

Issues, recommendations, and follow-up actions from the Fourth Five-Year Review are summarized in **Table 5-5.**

5.5 Technical Assessment

5.5.1 Question A: Is the Remedy Functioning as Intended by the Decision Document?

5.5.1.1 Parcel D-1

Yes. Based on the review of historical documents, annual O&M inspections, and the Five-Year Review inspection the remedy at Parcel D-1 is functioning as intended.

Soil hotspot areas were removed through excavation and offsite disposal. Exposure pathways to residual COCs that could result in an unacceptable risk are being controlled through durable covers and ICs. The shoreline revetment, soil cover, and asphalt cover are in good condition, and any minor issues have been repaired. Areas needing repair outside of typical O&M are secured to prevent access. Groundwater COCs have been consistently below TLs and RGs. The radiological component of the remedy is currently being revised to include the potential

presence of RO in soil deeper than 2 feet, in the interim, exposure pathways are being controlled through existing ICs. Radiological concerns are addressed through previous radiological surveys and remediation of soil and building structures and radiological retesting was initiated in 2023 to confirm that the RAO has been met, with the goal of unrestricted closure.

5.5.1.2 Parcel UC-1

Yes. Based on the review of historical documents, annual O&M inspections, and the Five-Year Review inspection the remedy at Parcel UC-1 is functioning as intended.

Exposure pathways that could result in an unacceptable risk are being controlled through durable covers and ICs. The soil and asphalt covers are in good condition, and any minor issues have been repaired. Radiological concerns are addressed through previous radiological surveys and remediation of soil and building structures and radiological retesting, with the goal of unrestricted closure. Radiological retesting was initiated in 2023.

5.5.1.3 Parcel D-2

There are no remedy components for Parcel D-2 in the decision document. Radiological concerns are addressed through previous radiological surveys and remediation of soil and building structures and radiological retesting, with the goal of unrestricted closure. Radiological was initiated in 2023.

5.5.1.4 Parcel G

Yes. Based on the review of historical documents, annual O&M inspections, and the Five-Year Review inspection the remedy at Parcel G is functioning as intended.

Soil hotspot areas were removed through excavation and offsite disposal. Exposure pathways to residual COCs that could result in an unacceptable risk are being controlled through durable covers and ICs. The durable covers are in good condition and any minor issues have been repaired. Groundwater monitoring of COCs is ongoing. In the interim, exposure pathways are being controlled through ICs. Radiological concerns are addressed through previous radiological surveys and remediation of soil and building structures and radiological retesting is being conducted to confirm that the RAO has been met, with the goal of unrestricted closure.

5.5.2 Question B: Are the Exposure Assumptions, Toxicity Data, Cleanup Levels, and Remedial Action Objectives Used at the Time of the Remedy Selection Still Valid?

Yes. Based on the results of the ARAR evaluation, HHRA analysis, and ERA analysis discussed in the following sections, the exposure assumptions, toxicity data, cleanup levels, and RAOs used at the time of remedy selection are still valid. Although there have been some changes to toxicity values and risk assessment methods, these changes do not affect remedy protectiveness.

5.5.2.1 ARAR Evaluation

The Navy evaluated the ARARs established in the RODs and ESD for Parcels D-1, D-2, G, and UC-1, collectively known as Former Parcel D. No changes to location-specific or action-specific ARARs that would affect the protectiveness of the remedies were identified. Changes to chemical-specific ARARs for individual chemicals are discussed in the HHRA and ERA Analysis that follows.

The California Public Resources Code Division 20.6.5, California Sea Level Rise Mitigation and Adaptation Act of 2021, was passed in 2021; however, no regulations have been promulgated to implement the Act. The Navy is addressing SLR as discussed in Section 2.2.2 of this Five-Year Review.

5.5.2.2 HHRA Analysis

As **Section 3.5.2.1** notes, in 2018, the State of California promulgated the TCR. However, the Navy continues to view the values identified in the USEPA IRIS database (a Tier 1 value) as the primary source of toxicity factors for risk-related calculations. The HHRA evaluation was conducted by comparing the human health RGs from the RODs to current risk-based criteria based on the same exposure scenario, and ARARs, if available. Response complete for soil was achieved with hotspot excavation, durable cover construction and maintenance, and ICs as documented in the respective RACRs for Parcel D-1, UC-1, and G (ERRG, 2011, 2013; APTIM, 2018; Arcadis, 2014a). Therefore, any changes in exposure assumptions and toxicity data would not affect protectiveness of the remedy.

Table 5-6 shows the RGs and current comparison criteria for groundwater. The RGs for the groundwater COCs included in the ROD were based on consideration of exposure scenario-specific (residential or industrial vapor intrusion and construction worker trench exposure [A-aquifer], or residential domestic use [B-aquifer]) risk-based concentrations (based on a cancer risk of 10-6 or a noncancer hazard index of 1), laboratory PQLs, chemical-specific ARARs, and Hunters Point groundwater ambient levels. RGs were compared to the following current comparison criteria (USEPA, 2002a):

- A-aquifer groundwater: VISLs calculated using the current USEPA VISL calculator for the residential and commercial scenarios.
- B-aquifer groundwater: current USEPA tapwater RSLs, California MCLs, and USEPA MCLs.

For the majority of the COCs where the risk-based concentration was selected as the RG, the current risk-based concentration (RSL or VISL) is higher. For groundwater, the current risk-based concentration (VISL) for TCE for the residential receptor is slightly lower than the risk-based RG from the ROD (see **Table 5-6**). Although current risk-based levels are lower than the RGs in some cases, the ICs that are currently in place and the durable cover across the site prevent exposure to site media, and therefore, the remedy remains protective. There may be changes with HHRA analysis for the construction worker scenario. Changes in exposure parameter values would likely only result in a small change to HHRA results since standard construction worker exposure factors have not changed significantly since the RI was prepared (not orders of magnitude). The following construction worker exposure parameter values have changed since the original HHRA was prepared:

- The construction worker body weight used in the HHRA was 70 kilograms; however, the adult body weight used in HHRAs based on current USEPA guidance (USEPA, 2014) would be 80 kilograms.
- The skin surface area for a construction worker exposed to soil used in the HHRA was 5,700 cm^2; however, based on current USEPA guidance (USEPA, 2014), a construction worker skin surface area exposed to soil is 3,527 cm^2.
- The soil-to-skin adherence factor used in the HHRA for a construction worker was 0.8 milligram per cm^2, where the soil-to-skin adherence factor for a construction worker used

in a current HHRA would be 0.3 milligram per cm^2 (the 95th percentile adherence factor for construction workers [USEPA, 2004]).

- The skin surface area for exposure to groundwater used in the HHRA was 2,370 cm^2. A current HHRA would use a skin surface area of 6,032 cm^2 (the weighted average of mean values for head, hands, forearms, and lower legs [USEPA, 2011]).
- Additionally, for inhalation exposures for both groundwater and soil, inhalation toxicity values are now presented and used in milligram(s) per cubic meter (noncancer) or 1 microgram per cubic meter for cancer; therefore, the intake equations no longer incorporate inhalation rate.

Toxicity values could result in larger changes (potential orders of magnitude changes), such as for TCE, for which toxicity values were updated in 2009 after the initial HHRA was completed. However, those changes will not affect the RGs for the construction worker scenario identified in the ROD because ICs require identification and management of potential risks to construction workers through the preparation and approval of plans and specifications for all construction activities that may pose unacceptable exposure to construction workers. There have been no changes in current exposure pathways based on the site controls, or changes in planned future site use since the ROD that would change the protectiveness of the current remedy.

Radiological Risk Review

In October 2020, after the preparation of the Five-Year Review addenda, USEPA introduced a PRG calculation method called “Peak PRG,” which computes PRGs accounting for ingrowth and decay of progeny over time. An evaluation was performed for this Five-Year Review to assess whether this change affected the continued protectiveness of the current soil RGs for future residents. Exposure calculations were performed using the USEPA PRG Calculator (USEPA, 2022b). For this soil evaluation, the estimated excess cancer risk was calculated using the “Peak Risk” time interval of 1,000 years (Navy, 2020). The soil RGs were used as exposure point concentrations and the cumulative cancer risk was calculated as the sum of risks from all ROCs. **Appendix F** presents the calculated estimated excess cancer risks calculated from this evaluation and the supporting data. Under CERCLA, cleanup goals are considered protective if excess cancer risks from site exposures remain within the 10^{-4} to 10^{-6} range. Based on the findings of this evaluation, the soil RGs are within this range and continue to be protective for future residential exposures.

There were no changes to the risk assessment methods related to structures or buildings for radiological concerns since the last Five-Year Review.

5.5.2.3 ERA Analysis

There were no COECs identified for Former Parcel D. However, groundwater has been monitored for chromium VI and nickel to evaluate potential for risk to aquatic organisms in San Francisco Bay should groundwater reach the bay. **Table 5-7** presents the TLs and current surface water quality criteria. The chronic marine NRWQC (USEPA, 2023) was set as the TL for chromium VI. This value has not changed since the ROD was completed. The TL for nickel is the HGAL and represents ambient conditions. The TLs remain current and protective of surface water exposures for aquatic organisms. Surface water TLs are for monitoring purposes only as surface water benchmarks are not ARARs for ecological exposures to groundwater.

5.5.3 Question C: Has Any Other Information Come to Light that Could Question the Protectiveness of the Remedy?

Yes. As identified in the Fourth Five-Year Review there is uncertainty with a portion of the radiological survey and remediation work. The Navy is in the process of implementing corrective actions to ensure the radiological remedies specified in the decision documents were implemented as intended; however, this work is ongoing. Radiological retesting is currently being conducted at Parcels G, D-1, D-2, and UC-1; long-term protectiveness will be confirmed upon completion.

5.6 Issues, Recommendations, and Follow-up Actions

Issues, recommendations, and follow-up actions were identified for Parcels D-1, UC-1, D-2, and G as summarized in **Table 5-8**.

5.6.1 Other Findings

The following findings were identified that do not directly relate to achieving or maintaining remedy protectiveness but are relevant to overall site management.

5.6.1.1 PFAS

As discussed in **Section 1.4.1,** a Basewide PA was conducted to identify potential PFAS release areas based on historical use or limited sampling data. The following is a summary of the areas identified for additional investigation in the PA (Multi-MAC JV, 2022) and SI (Liberty JV, 2023b):

- **Parcels D-1 and G A-aquifer groundwater:** A-aquifer groundwater beneath Parcels D-1 and G was identified for additional investigation because of past industrial use in the Parcels and PFOA, PFOS, and PFHxS exceeded project screening levels in soil and groundwater during the SI (**Appendix G**).
- **Parcel D-1:** Poseidon Area (Buildings 377, 384, 385, and 387), IR-69 (Bilge Water Pump House), and IR-70 (Former drum and tank storage area) were identified as areas where further investigation is warranted to determine the presence of PFAS in soil based on historical site use. Upon further review and visual inspections, the Poseidon Area was not sampled in the SI as there was limited soil to sample and any release that may have occurred as a result of site operations would have been released into San Francisco Bay over 40 years ago (no later than 1972). It is also significant to note that this area was identified for the storage of AFFF but there is no evidence that a release of AFFF had occurred (Liberty JV, 2023a). However, it was recommended for further investigation because PFAS were detected in other areas of HPNS.
- **Parcel G:** IR-09 (Pickling and Plating Yard) was identified as an area where further investigation is warranted based on historical site use and limited groundwater sampling results that contained PFOA PFOS, PFBS, and PFHxS. PFOA, PFOS, and PFHxS exceeded project screening levels in groundwater during the SI.

There were no areas identified for investigation in Parcels D-2 and UC-1. Exposure to groundwater and soil is restricted by ICs within the HPNS and the City and County of San Francisco prohibits installation of domestic wells within city and county limits.

5.6.1.2 Climate Resilience

The CRA estimates that groundwater emergence due to SLR may occur within Parcel D-1 by the year 2035 and Parcel G by the year 2065 (**Appendix A**). Site-specific studies are planned to verify these mapping projections and evaluate the 2100 timeframe, at a minimum. Parcel D-1 will be prioritized and is scheduled to be initiated in 2025.

However, protectiveness is only affected when increased CERCLA risk attributable to climate hazards has been identified (groundwater is likely to emerge and land use is such that receptors could be exposed and a future unacceptable health or ecological risk has been identified, data collected, validated, and evaluated following CERCLA risk assessment processes resulting in unacceptable risk to receptors). Where the potential for increased vapor intrusion is identified in other CERCLA documents, ARICs for VOCs are present, groundwater is being monitored, and removal of VOCs is occurring either through MNA or active remediation, thus reducing the potential for future vapor intrusion by reducing the source. Therefore, the potential for groundwater emergence does not affect the protectiveness determination in this Five-Year Review.

There are no anticipated effects of SLR on Parcels D-2 and UC-1.

A site-specific study is recommended at Parcels D-1 and G to assess whether the projected climate change vulnerabilities are likely to result in additional CERCLA risk.

5.6.1.3 Site Management Strategy

The Navy is reassessing the site management strategy for Parcels D-1 and G based on the following considerations:

- The Navy is planning to conduct a detailed assessment of groundwater COC concentrations to document and eliminate COCs that have achieved response complete and to tabulate groundwater and soil COC concentrations to ensure health and safety professionals have the information needed to protect future construction workers.
- The Navy is also planning to optimize the monitoring frequency and locations for areas that have not undergone any changes that could affect the concentrations of chemicals and/or metals in groundwater (for example, remedial action or development construction). Optimize, in this case, means to balance the cost of continued monitoring at the frequency and locations with the land use. It could mean decreasing or increasing depending on whether land use changes that could affect exposure. For example, reducing monitoring frequency when the parcel is awaiting transfer and is generally unused and increasing frequency upon transfer and land use changes from construction or other activities.

5.7 Statement of Protectiveness

5.7.1 Parcel D-1

Protectiveness Determination: Short-term Protective

Protectiveness Statement: The remedy at Parcel D-1 is currently protective of human health and the environment. In order to determine whether the remedy can be considered protective in the long term, the radiological retesting work will be completed, and additional actions implemented to address the potential presence of ROs in subsurface soil.

The RAOs for soil are met through soil hotspot excavation and offsite disposal, durable covers, and ICs. Groundwater monitoring is ongoing and COCs have been consistently below RGs and

TLs. Radiological retesting is ongoing to confirm that levels in soil and existing structures are protective of human health and post-ROD documentation is being prepared to address ROs in subsurface soil. Until retesting is complete, short-term protectiveness is met through Navy controls such as access to the parcel through fencing, locked gates, and ICs (restricting intrusive work and maintaining durable covers).

5.7.2 Parcel D-2

Protectiveness Determination: Short-term Protective

Protectiveness Statement: The remedy at Parcel D-2 is currently protective of human health and the environment.

Parcel D-2 was acceptable for UU/UE upon completion of the radiological TCRA; however, in order to determine whether the parcel remains acceptable for UU/UE, the radiological retesting work will be completed. Until retesting is complete, exposure to ROCs in site media is being controlled through security features such as fencing, locked gates, and signage.

5.7.3 Parcel UC-1

Protectiveness Determination: Short-term Protective

Protectiveness Statement: The remedy at Parcel UC-1 is currently protective of human health and the environment. In order to determine whether the remedy can be considered protective in the long term, the radiological retesting work will be completed.

The RAOs for soil are met through durable covers and ICs. Radiological retesting is ongoing to confirm that levels in soil and existing structures are protective of human health. Until retesting is complete, short-term protectiveness is met through Navy controls such as access to the parcel through fencing, locked gates, and ICs (restricting intrusive work and maintaining durable covers).

5.7.4 Parcel G

Protectiveness Determination: Short-term Protective

Protectiveness Statement: The remedy at Parcel G is currently protective of human health and the environment. In order to determine whether the remedy can be considered protective in the long term, the radiological retesting work will be completed.

The RAOs for soil are met through soil hotspot excavation and offsite disposal, durable covers, and ICs. Groundwater treatment is completed, and monitoring is ongoing. Radiological retesting is ongoing to confirm that levels in soil and existing structures are protective of human health. While retesting is ongoing, short-term protectiveness is met through Navy controls such as access to the parcel through fencing, locked gates, and ICs (restricting intrusive work and maintaining durable covers).

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Table 5-1. Parcels D-1, G, and UC-1 Chemicals of Concern and Remediation Goals

Exposure Medium	Exposure Scenario	Chemical of Concern	ROD Remediation Goal (2009)	Source of Remediation Goal	Parcel
Soil (mg/kg)	Residential	Manganese	1,431	HPAL	D-1, UC-1, G
		Arsenic	11.1	HPAL	D-1, UC-1
		Benzo(a)pyrene	0.33	PQL	D-1, UC-1
		Benzo(b)fluoranthene	1.76	RBC	D-1, UC-1
	Recreational	Arsenic	11.1	HPAL	G
		Benzo(a)pyrene	0.33	PQL	G
	Industrial	Arsenic	11.1	HPAL	G
		Benzo(a)pyrene	0.33	PQL	G
		Benzo(b)fluoranthene	1.76	RBC	G
		Lead	800	RBC	G
	Construction Worker	Arsenic	11.1	HPAL	D-1, UC-1, G
		Benzo(a)pyrene	0.65	RBC	D-1, UC-1, G
		Lead	800	RBC	G
		Manganese	6,889	RBC	D-1, UC-1, G
Groundwater (µg/L)	Residential – Vapor Intrusion	Chloroform	1	PQL	G
		Methylene Chloride	27	RBC	G
		Trichloroethene	2.9	RBC	G
	Industrial – Vapor Intrusion	Benzene	0.63	RBC	D-1, UC-1, G
		Carbon Tetrachloride	0.5	PQL	D-1, UC-1, G
		Chloroform	1.2	RBC	D-1, UC-1, G
		Naphthalene	6	RBC	D-1, UC-1, G
		Tetrachloroethene	1	PQL	D-1, UC-1, G
		Trichloroethene	4.8	RBC	D-1, UC-1, G
		Xylene (total)	337	RBC	D-1, UC-1, G
	Construction Worker – Trench Exposure	Arsenic	40	RBC	D-1, UC-1, G
		Benzene	17	RBC	D-1, UC-1, G
		Naphthalene	17	RBC	D-1, UC-1, G
		Tetrachloroethene	18	RBC	D-1, UC-1, G
		Xylene (total)	861	RBC	D-1, UC-1, G
	Migration to Surface Water of Bay [a]	Chromium VI	50	SWC	D-1, UC-1, G
		Nickel	96.5	HPAL	D-1, UC-1, G

[a] Migration to Surface Water of Bay addresses discharge that would be above the specified remediation goals; specific trigger levels are developed for each plume. Groundwater remediation goals for chromium VI and zinc are at the point of discharge to the bay.

µg/L = microgram(s) per liter
HPAL = Hunters Point ambient level
PQL = practical quantitation limit
RBC = risk-based concentration
ROD = Record of Decision
SWC = Surface Water Criteria

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Table 5-2. Parcels D-1, G, and UC-1 Remediation Goals for Radionuclides

Radionuclide	Surfaces (dpm/100cm^2)		Soil (pCi/g)		Water (pCi/L)	Parcel
	Equipment and Waste[a]	Structures[b]	Construction Worker[c]	Resident[e]		
Cesium-137	5,000	5,000	0.113	0.113	119	D-1, G, UC-1
Cobalt-60	5,000	5,000	0.0602	0.0361	100	D-1, G, UC-1
Plutonium-239	100	100	14	2.59	15	D-1, G, UC-1
Radium-226	100	100	1[d]	1[d]	5	D-1, G, UC-1
Strontium-90	1,000	1,000	10.8	0.331	8	D-1, G, UC-1
Thorium-232	1,000	36.5	19	1.69	15	D-1, G, UC-1
Hydrogen-3	5,000	5,000	4.23	2.28	20,000	D-1, G, UC-1
Uranium-235 + daughters	5,000	488	0.398	0.195	30	D-1, G, UC-1

Source of Goals:

Department of the Navy (Navy). 2006. *Base-wide Radiological Removal Action, Action Memorandum – Revision 2006, Hunters Point Shipyard, San Francisco, California*. Final. April 21.

United States Environmental Protection Agency (USEPA). 2000. *Radionuclides Notice of Data Availability Technical Support Document*. Targeting and Analysis Branch, Standards and Risk Management Division, Office of Groundwater and Drinking Water. March.

[a] Limits for removable surface activity are 20 percent of these values.

[b] Remediation goals are consistent with those issued in the Radiological TCRA Action Memo. Remediation goals meet the 25 millirem per year residual dose level consistent with 10 CFR Section 20.1402. Furthermore, for most radionuclides of concern, goals meet the 15 millirem per year residual dose level consistent with the 1997 USEPA OSWER Directive (OSWER No. 9200.4-18). Of exception, is the goal for Thorium-232 which because of detection limit technical limitations, corresponds to a dose of 25 millirems per year.

[c] Applicable to Parcel G only

[d] Goal is 1 pCi/g above background per agreement with USEPA.

[e] All radiologically impacted soils in this parcel will be remediated according to Residential Remediation Goals.

Note:
Unless otherwise stated, the radiological remediation goals in this table are based on total activity per sample including the background.

CFR = Code of Federal Regulations
cm^2 = square centimeter(s)
dpm = disintegration(s) per minute
OSWER = Office of Solid Waste and Emergency Response
pCi/g = picocurie(s) per gram
pCi/L = picocurie(s) per liter
TCRA = time-critical removal action
USEPA = United States Environmental Protection Agency

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Table 5-3. Parcel D-1 and UC-1 Remedial Action Summary and Expected Outcomes

Media	Risk/Basis for Action	Reasonably Anticipated Land Use	RAO	Remedy Component	Parcel	Performance Metric	Expected Outcome
Soil	**Human Health:** Unacceptable risks to potential future industrial or construction workers from exposure to PAHs and metals in surface and subsurface soils. Potential volatilization of VOCs from soil into soil gas and/or indoor air via the VI pathway.	**Current use:** Limited access, unoccupied and unused buildings **Planned Future Use:** Multiuse including residential, research and development, and open space	1. Prevent exposure to PAHs and metals in soil at concentrations above remediation goals developed in the HHRA for the following exposure pathways: Ingestion of, outdoor inhalation of, and dermal exposure to surface and subsurface soil by industrial workers or construction workers 2. Prevent exposure to VOCs in soil gas at concentrations that would pose unacceptable risk via indoor inhalation of vapors. Remediation goals for VOCs to address exposure via indoor inhalation of vapors may be superseded based on COC identification information from future soil gas surveys. Future action levels would be established for soil gas, would account for vapors from both soil and groundwater, and would be calculated based on a cumulative risk level of 10^{-6} using the accepted methodology for risk assessments at HP[N]S.	Excavation	D-1	Excavation and offsite disposal of COC-contaminated soil to industrial-based RGs. One soil stockpile identified in the remedial design was also removed and disposed offsite.	Land suitable for planned future use compatible with durable covers and ICs as required by the LUC RD.
				Durable Covers	D-1 and UC-1	Durable covers to provide physical barriers to prevent exposure to PAHs and metals in soil. Durable covers include: 1) a 3-foot-thick (minimum) shoreline armoring (D-1 only) 2) a 2-foot-thick (minimum) vegetated soil cover (UC-1 only) 3) a 6-inch-thick (minimum) asphaltic pavement cover 4) repaired concrete building foundations Covers are inspected and maintained to prevent exposure to COCs.	
				ICs	D-1 and UC-1	ICs to maintain durable covers, restrict land use and land-disturbing activity and, in areas for VOC ICs, prohibit construction of enclosed structures unless prior written approval is granted by the FFA signatories	
Groundwater	**Human Health:** Unacceptable risks to potential future industrial or construction workers from exposure to VOCs in indoor air from A-aquifer groundwater via the vapor intrusion pathway. Unacceptable risks to potential future construction workers through dermal contact with metals and VOCs in A-aquifer groundwater and volatilization of VOCs.		1. Prevent exposure by industrial workers to VOCs in the A-aquifer groundwater at concentrations above remediation goals via indoor inhalation of vapors from groundwater. 2. Prevent or minimize exposure of construction workers to metals and VOCs in the A-aquifer groundwater at concentrations above remediation goals from dermal exposure and inhalation of vapors from groundwater.	Groundwater treatment	D-1	A pre-ROD groundwater treatability study was completed, consisting of injection of approximately 136,000 pounds of zero valent iron into the A-aquifer. Concentrations of VOCs were treated to below RGs established for D-1 groundwater and active treatment was not required.	
				Groundwater LTM	D-1	Groundwater monitoring is ongoing. VOC monitoring was discontinued in 2012 when RGs were met. Concentrations of metals continue to be below RGs and TLs since 2004 with the exception of silver in July 2008 and lead in September 2015 in 1 monitoring well.	
				ICs	D-1	ICs to prohibit construction of enclosed structures, the use of groundwater and installation of new groundwater wells for domestic purposes, and to restrict land-disturbing activity unless prior written approval is granted by the FFA signatories.	
Radiologically Impacted Soil and Structures	**Human Health:** Radiological risks for soil and structures (storm drains, sanitary sewers, buildings) were greater than 10^{-6}.		1. Prevent exposure to radionuclides of concern in concentrations that exceed remediation goals for all potentially complete exposure pathways.	Survey, decontamination, and removal of radiologically impacted structures and soil	D-1 and UC-1	Radiologically impacted structures and soil was removed during the Basewide TCRA. Low-level radiological objects were identified in soil within Parcel D-1 and may be present at depths greater than 2 feet bgs. Additional remedy evaluation is currently under way to address these objects. Additionally, radiological rescanning is currently being completed. While the remedy evaluation and retesting is underway, exposure pathways are being controlled through ICs.	

Table 5-3. Parcel D-1 and UC-1 Remedial Action Summary and Expected Outcomes

bgs = below ground surface
COC = chemical of concern
FFA = Federal Facilities Agreement
HHRA = human health risk assessment
HPNS = Hunters Point Naval Shipyard (referred in the ROD as HPS)
IC = institutional control
LTM = long-term monitoring
LUC = land use control
PAH = polycyclic aromatic hydrocarbon
RAO = remedial action objective
RD = remedial design
RG = remediation goal
ROD = Record of Decision
TCRA = time-critical removal action
TL = trigger level
VI = vapor intrusion
VOC = volatile organic compound

Table 5-4. Parcel G Remedial Action Summary and Expected Outcomes

Media	Risk/Basis for Action	Reasonably Anticipated Land Use	RAO	Remedy Component	Performance Metric	Expected Outcome
Soil	**Human Health:** Unacceptable risks to potential future industrial, residential, or construction workers from exposure to PAHs and metals in surface and subsurface soils. Potential volatilization of VOCs from soil into soil gas and/or indoor air via the VI pathway.	**Current use:** Limited access unoccupied and unused buildings, few commercial buildings **Planned Future Use:** Multiuse including residential, research and development, and open space	1. Prevent exposure to organic and inorganic chemicals in soil at concentrations above remediation goals developed in the HHRA for the following exposure pathways: a) Ingestion of, outdoor inhalation of, and dermal exposure to surface and subsurface soil b) Ingestion of homegrown produce by residents in mixed-use blocks	Excavation	Excavation and offsite disposal of COC-contaminated soil to industrial-based RGs. Two soil stockpiles identified in the remedial design were also removed and disposed offsite.	Land suitable for planned future use compatible with durable covers and ICs as required by the LUC RD.
				Durable Covers	Durable covers to provide physical barriers to prevent exposure to PAHs and metals in soil. Durable covers include: 1) a 6-inch-thick (minimum) asphaltic pavement cover and 2) repaired concrete building foundations. Covers are inspected and maintained to prevent exposure to COCs.	
				ICs	ICs to maintain durable covers, restrict land use and land-disturbing activity, and prohibit growing produce in native soil for human consumption in mixed-use blocks.	
			2. Prevent exposure to VOCs in soil gas at concentrations that would pose unacceptable risk via indoor inhalation of vapors. Remediation goals for VOCs to address exposure via indoor inhalation of vapors may be superseded based on COC identification information from future soil gas surveys. Future action levels would be established for soil gas, would account for vapors from both soil and groundwater, and would be calculated based on a cumulative risk level of 10^{-6} using the accepted methodology for risk assessments at HP[N]S.	ICs	ICs to prohibit construction of enclosed structures unless prior written approval of vapor mitigation strategies is granted by the FFA signatories.	
Groundwater	**Human Health:** Unacceptable risks to potential future industrial, residential, or construction workers from exposure to VOCs in indoor air from A-aquifer groundwater via the vapor intrusion pathway. Unacceptable risks to potential future construction workers through dermal contact with metals and VOCs in A-aquifer groundwater and volatilization of VOCs. Potential migration pathway of contaminants to San Francisco Bay.		1. Prevent exposure to VOCs in the A-aquifer groundwater at concentrations above remediation goals via indoor inhalation of vapors from groundwater. 2. Prevent direct exposure to the groundwater that may contain COCs through the domestic use pathway (for example, drinking water or showering). 3. Prevent or minimize exposure of construction workers to metals and VOCs in the A-aquifer groundwater at concentrations above remediation goals from dermal exposure and inhalation of vapors from groundwater. 4. Prevent or minimize migration to the surface water of San Francisco Bay of chromium VI and nickel in A-aquifer groundwater that would result in concentrations of chromium VI above 50 µg/L, and nickel above 96.5 µg/L at the point of discharge to the Bay.	Groundwater treatment	A pre-ROD groundwater treatability study was completed, consisting of injection of approximately 136,000 pounds of zero valent iron into the A-aquifer. Concentrations of VOCs were below the RGs in all monitoring wells except one location at the time of the RD, therefore additional treatment was determined to be unnecessary.	
				Groundwater monitoring	Groundwater monitoring is ongoing. Sampling for hexavalent chromium was discontinued in 2012 because concentrations were below TLs and were stable or decreasing. VOCs continue to exceed RGs and monitoring will continue until RGs have been met.	
				ICs	ICs to prohibit extraction of groundwater and installation of new groundwater wells with the exception of environmental sampling and monitoring requirements described in the ROD. ICs within areas with VOCs to prohibit construction of enclosed structures unless prior written approval is granted by the FFA signatories.	
Radiologically Impacted Soil and Structures	**Human Health:** Radiological risks for soil and structures (storm drains, sanitary sewers, buildings) were greater than 10^{-6}.		1. Prevent exposure to radionuclides of concern in concentrations that exceed remediation goals for all potentially complete exposure pathways.	Survey, decontamination, and removal of radiologically impacted structures and soil	Radiologically impacted structures and soil was removed during the Basewide TCRA. Radiological retesting is currently being completed. While the rescanning is underway, exposure pathways are being controlled through ICs.	Land suitable for planned future use compatible with durable covers and ICs as required by the LUC RD.

Table 5-4. Parcel G Remedial Action Summary and Expected Outcomes

µg/L = microgram(s) per liter
COC = chemical of concern
FFA = Federal Facilities Agreement
HHRA = human health risk assessment
HPNS = Hunters Point Naval Shipyard (referenced in ROD as HPS)
IC = institutional control
LTM = long-term monitoring
LUC = land use control
PAH = polycyclic aromatic hydrocarbon
RAO = remedial action objective
RD = remedial design
RG = remediation goal
ROD = Record of Decision
TCRA = time-critical removal action
TL = trigger level
VI = vapor intrusion
VOC = volatile organic compound

Table 5-5. Fourth Five-Year Review Parcels D-1, D-2, UC-1, and G Issues, Recommendations, and Follow-up Actions

Parcel/ Site	Fourth Five-Year Review Protectiveness	Issue	Recommendation (Milestone)	Date Complete/ Current Status
D-1, G	Short-term protective	The regulatory agencies do not agree with the Navy's risk assessment methodology used to reduce the ARICs for VOC vapors.	The Navy intends to consider agency concerns (including specific recommendations made by EPA) and reevaluate its approach to calculating SGALs, which may affect the ARICs for VOC vapors at Parcels B-1, B-2, D-1, and G. Appendix E (of the Fourth Five-Year Review) evaluated how EPA's recommendations may affect the SGALs and the ARICs for VOC vapors. Based on the information in Appendix E, none of the potential changes to the ARICs for VOC vapors affect the current protectiveness of the remedies at Parcels B-1, B-2, D-1, and G. The regulatory agencies are currently reviewing and reevaluating their methods for assessing vapor intrusion risk. Once consensus is achieved, the Navy should reevaluate its approach for calculating SGALs and adjusting ARICs for VOC vapors. The new SGALs would be developed based on the most current standards, toxicity criteria, and risk assessment methods. The new SGALs would be used to redefine the ARICs for soil gas at each parcel prior to property transfer. Any changes to soil gas risk assessment methodology should be discussed in the next Five-Year Review report. (12/31/2019)	No changes to the VOC ARIC are planned for Parcel D-1 or G at this time. Because attenuation of VOCs is likely to occur, ARICs for VOC vapors, and likewise SGALs that are the basis of the ARICs, in Parcels D-1 and G will be re-evaluated during preparation for property transfer. While there is disagreement about the method to calculate the SGALs, which may affect ARIC boundaries, the final ARICs that will be surveyed and recorded in quitclaim deeds and covenants to restrict land use will be established in agreement with the BCT. Protectiveness is not affected because the Navy currently controls the property and land use, and future protectiveness will not be affected because the ARICs will be established in the appropriate legal documentation.
D-1, D-2, UC-1, and G	Short-term protective	The Navy has determined that a significant portion of the radiological survey and remediation work completed to date was not reliable because of manipulation and/or falsification of data by one of its radiological contractors. A long-term protectiveness evaluation of the radiological RGs has not yet been completed for this fourth Five-Year Review, and it is currently not known if the RAOs for radionuclides have been achieved in Parcels B-1, B-2, C, D-1, D-2, G, E, UC-1, UC-2, and UC-3.	Refer to **Section 1.4.3** for the long-term protectiveness evaluation component of this recommendation. The Navy is in the process of implementing corrective actions to ensure that the radiological remedies specified in the decision documents are implemented as intended. It is anticipated that the radiological rework will be completed prior to the next Five-Year Review.	**Long-term Protectiveness Evaluation: Completed June 2020**. Addenda to the Fourth Five-Year Review were prepared to evaluate the Radiological RGs for soil and buildings. The conclusions of both reports were that the current RGs were protective of human health and the environment (Navy, 2020a, 2020b). **In Progress.** The radiological retesting of soil and surveys of building structures at Parcel D-1 was initiated in 2023. Radiological rework will be summarized in a radiological RACR anticipated to be completed in 2026. Planning for the radiological retesting of soil and building structures at Parcels D-2 and UC-1 was initiated in February 2019. Fieldwork activities were initiated in 2023. Radiological rework will be summarized in a radiological removal action construction summary report anticipated to be completed in 2028. The radiological retesting of soil and building structures at Parcel G was initiated in Fall 2018. Fieldwork activities were initiated in Fall 2020. Radiological rework will be summarized in a radiological RACR anticipated to be completed in 2025.

References:

Navy. 2020a. *Addendum to the Five-Year Review, Evaluation of Radiological Remedial Goals for Soil, Hunters Point Naval Shipyard, San Francisco, California*. June 18.

Navy. 2020b. *Addendum to the Five-Year Review, Evaluation of Radiological Remedial Goals for Building Structures, Hunters Point Naval Shipyard, San Francisco, CA*. June 18.

ARIC = area requiring institutional controls
BCT = BRAC Cleanup Team
BRAC = Base Realignment and Closure
Navy = Department of the Navy
RG = remediation goal
RACR = removal action completion report
SGAL = soil gas action level
USEPA = United States Environmental Protection Agency
VOC = volatile organic compound

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Table 5-6. Parcels D-1, G, and UC-1 Chemicals of Concern and Current Comparison Criteria for Groundwater

Exposure Medium	Exposure Scenario	Chemical of Concern	Values from ROD			Current Comparison Criteria				
			ROD Remediation Goal (2009, 2010)	Source of Remediation Goal	Parcel	11/2022 USEPA RSL or VISL	Basis of RSL or VISL (C/NC)[a]	DTSC-SL	Cal MCL	USEPA MCL
Groundwater (µg/L)	Residential – Vapor Intrusion	Chloroform	1	PQL	G	0.814	C	NA	80	80
		Methylene Chloride	27	RBC	G	763	C	NA	5	5
		Trichloroethene	2.9	RBC	G	1.19	C	NA	5	5
	Industrial – Vapor Intrusion	Benzene	0.63	RBC	D1, UC-1, G	6.93	C	NA	1	5
		Carbon Tetrachloride	0.5	PQL	D1, UC-1, G	1.81	C	NA	0.5	5
		Chloroform	1.2	RBC	D1, UC-1, G	3.55	C	NA	80	80
		Naphthalene	6	RBC	D1, UC-1, G	20.1	C	NA	None	None
		Tetrachloroethene	1	PQL	D1, UC-1, G	65.2	C	NA	5	5
		Trichloroethene	4.8	RBC	D1, UC-1, G	7.4	C	NA	5	5
		Xylene (total)	337	RBC	D1, UC-1, G	1620	NC	NA	1,750	10,000
	Construction Worker – Trench Exposure	Arsenic	40	RBC	D1, UC-1, G	NA		NA	NA	NA
		Benzene	17	RBC	D1, UC-1, G	NA	C	NA	NA	NA
		Naphthalene	17	RBC	D1, UC-1, G	NA	C	NA	NA	NA
		Tetrachloroethene	18	RBC	D1, UC-1, G	NA	C	NA	NA	NA
		Xylene (total)	861	RBC	D1, UC-1, G	NA	NC	NA	NA	NA

[a] VISL presented for A-aquifer groundwater

Note:
Shading indicates current comparison criteria is lower than ROD Remediation Goal.

µg/L = microgram(s) per liter
C = carcinogen
DTSC = California Department of Toxic Substances Control
MCL = maximum contaminant level
NA = not available
NC = noncarcinogen
PQL = practical quantitation limit
RBC = risk-based concentration
ROD = Record of Decision
RSL = Regional Screening Level
SL = screening level
USEPA = United States Environmental Protection Agency
VISL = vapor intrusion screening level

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Table 5-7. Parcels D-1, UC-1, and G Chemicals of Potential Concern for Ecological Receptors – Groundwater

Exposure Medium	Exposure Scenario	Chemical of Concern	ROD Trigger Level (2009)	Source of Trigger Level	Receptor Basis	NRWQC (2023)	Basin Plan SF Bay (2019)	Value Still Protective?	Notes
Groundwater (µg/L)	Ecological Receptor	Chromium VI	50	NRWQC - CCC	aquatic organisms	50	50	Yes	Analyte was included in the monitoring plan for Parcel D. The trigger level is a risk based criteria for surface water exposures but is not an ARAR for ecological exposure to groundwater. Exceeding the trigger level does not indicate immediate risk but a potential exists if the plume migrates toward the bay.
		Nickel	96.5	HGAL	aquatic organisms	8.2 (D)	8.2 (D)	Yes	The trigger level is based on ambient levels and is not a risk-based value. Risk-based criteria for surface water (NRWQC and Basin Plan) are for comparison purposes only and are not ARARs for groundwater exposures.

µg/L = microgram(s) per liter
ARAR = applicable or relevant and appropriate requirement
CCC = Criterion Continuous Concentration
(D) = dissolved
HGAL = Hunters Point groundwater ambient level
NRWQC = National Recommended Water Quality Criteria
ROD = Record of Decision

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Table 5-8. Parcels D-1, D-2, UC-1, and G Issues, Recommendations, and Follow-up Actions

Parcel	Issue	Recommendations/ Actions	Party Responsible	Oversight Agency	Milestone Date	Affects Protectiveness (Y/N)	
						Current	Future
D-1	As identified in the Fourth Five-Year Review there is uncertainty with a portion of the radiological survey and remediation work performed between 2004 and 2016 under the Basewide Radiological Removal Action, Action Memorandum (Navy, 2006). The Navy is in the process of implementing corrective actions to ensure the radiological remedies specified in the decision documents were implemented as intended; however, this work is ongoing.	Complete radiological retesting at radiologically impacted sites, including current and former buildings and soil areas investigated under the Radiological Removal Action, Action Memorandum (Navy, 2006) and areas where evaluations determined previous data were unreliable.	Navy	USEPA	11/27/2026	N	Y
UC-1					3/2/2028		
D-2					3/2/2028		
G					10/2/2025		
D-1	ROs were identified during excavation and remediation of soil in areas that were not considered radiologically impacted. There is a high degree of confidence that discrete ROs were removed to a depth of 2 feet bgs. However, there is a potential for ROs to be present in material below 2 feet bgs where shoreline expansion has occurred since 1946.	Evaluate additional remedies to address the potential presence of ROs in material 2 feet bgs and prepare the appropriate post-ROD documentation.	Navy	USEPA	12/20/2024	N	Y

Source: Navy. 2006. *Base-wide Radiological Removal Action, Action Memorandum – Revision 2006, Hunters Point Shipyard, San Francisco, California*. Final. April 21.

bgs = below ground surface
Navy = Department of the Navy
RO = radiological object
ROD = Record of Decision
USEPA = United States Environmental Protection Agency

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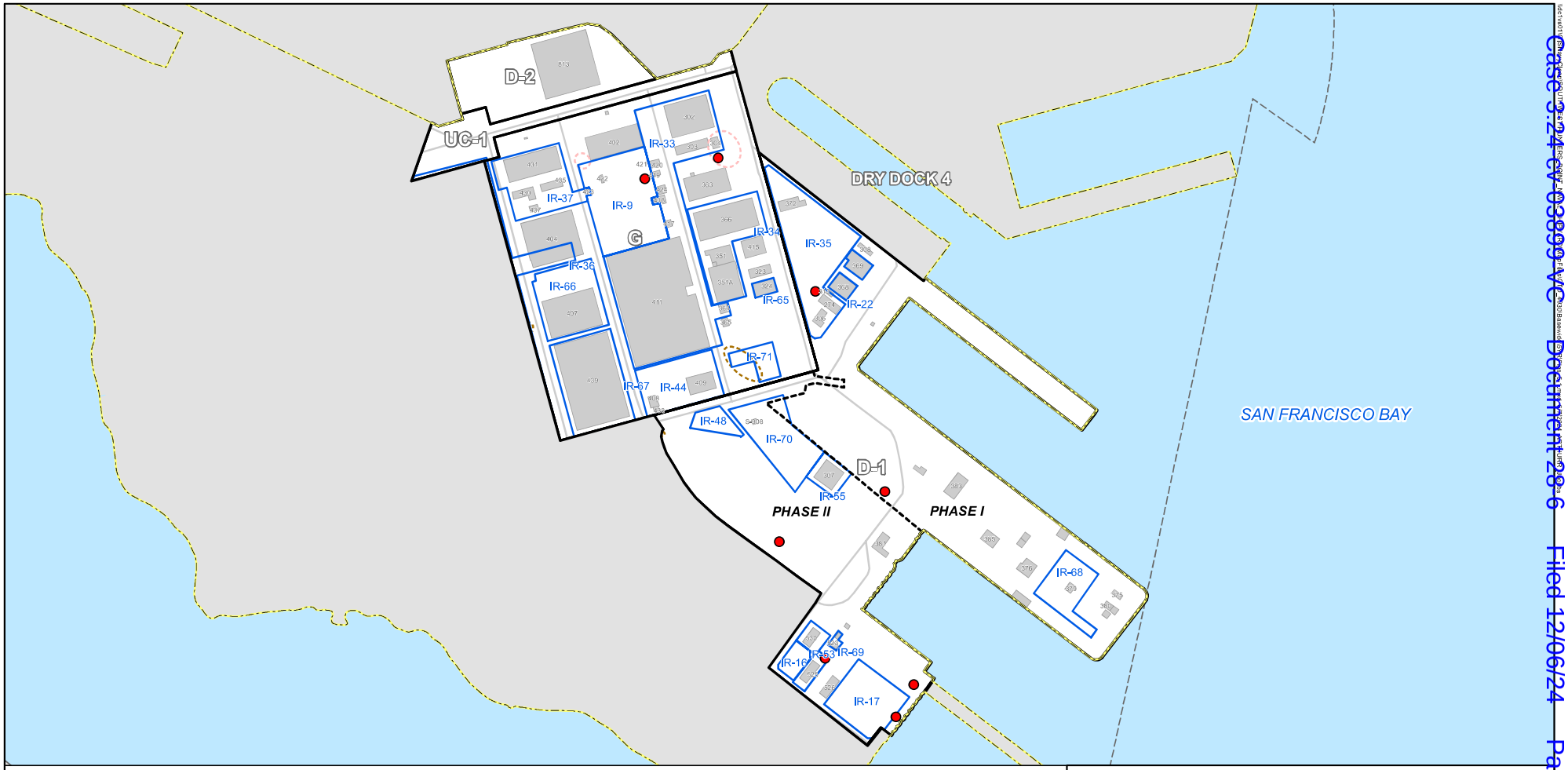
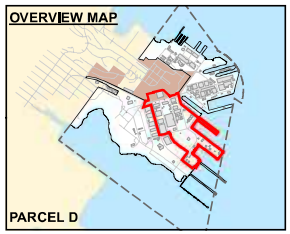


LEGEND

- Hunters Point Naval Shipyard Boundary
- Parcel Boundary
- Parcel F (Water) Boundary
- IR Site
- Approximate Hotspot Excavation Areas
- Water
- Building
- Road
- Phase II Boundary
- **Plume Detection Area**
- Naphthalene
- VOC



IR = Installation Restoration
VOC = volatile organic compound

0 225 450 Feet
1 inch = 450 feet

N

Parcel D (Parcels D-1, D-2, G, and UC-1)

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Hunters Point Naval Shipyard, San Francisco, California

NAVFAC

Figure 5-1

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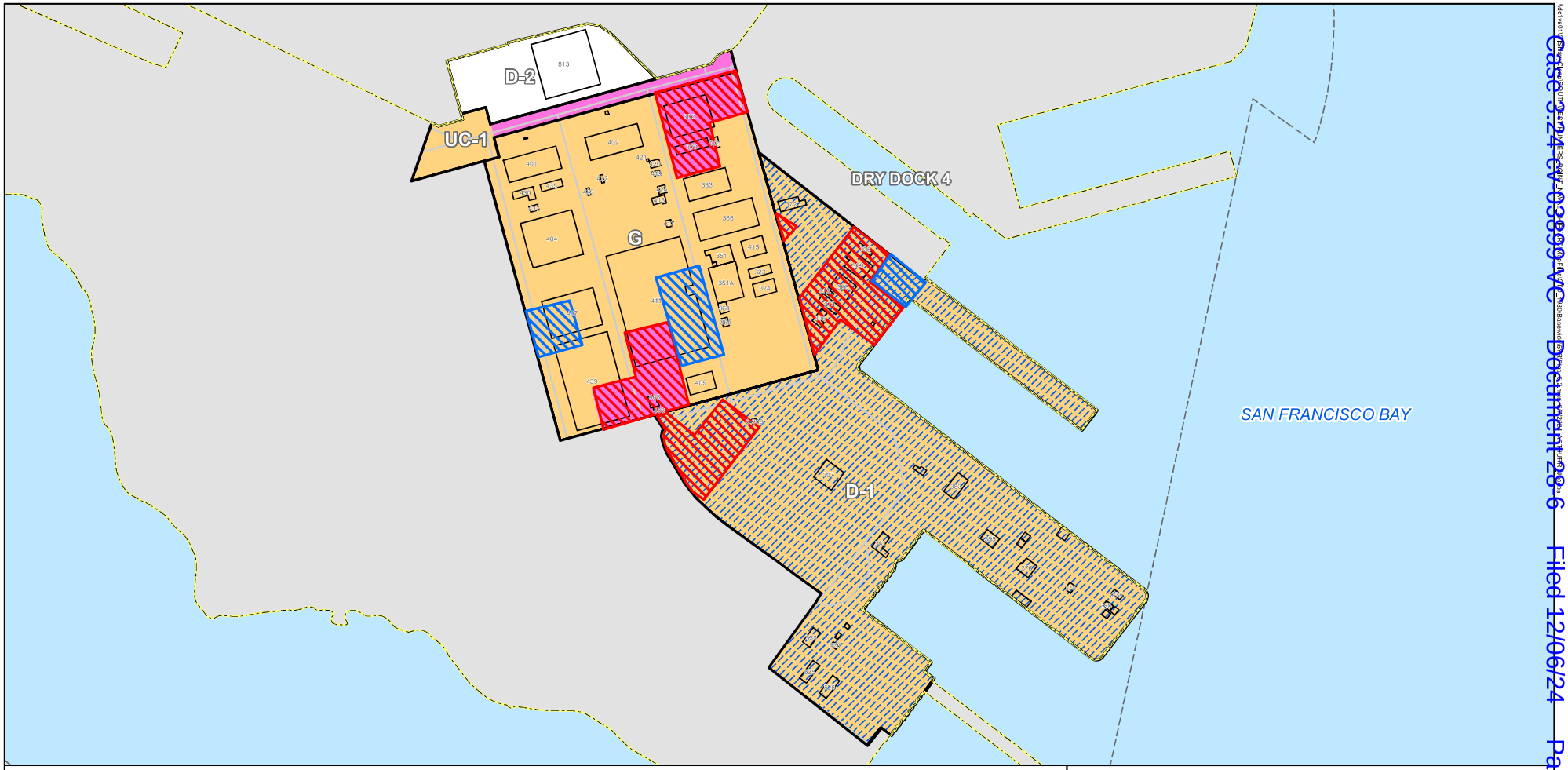
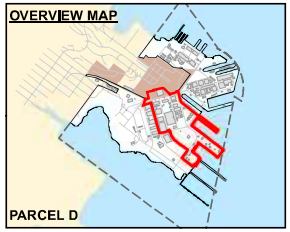


LEGEND

- Hunters Point Naval Shipyard Boundary
- Parcel Boundary
- Parcel F (Water) Boundary
- Water
- Building
- Road

Institutional Controls

- Additional Restrictions (Open Space, Educational/Cultural, and/or Maritime/Industrial Use
- ARIC for Soil and Groundwater Use (General)
- ARIC for Soil, Groundwater Use, and Restrictions Related to VOC Vapors
- Existing VOC ARIC
- Area Requiring Further Evaluation for VOCs based on Fourth Five-Year Review



ARIC = area requiring institutional controls
VOC = volatile organic compound

0 200 400 Feet
1 inch = 450 feet

N

Parcel D (Parcels D-1, D-2, UC-1, and G) Institutional Controls

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Figure 5-2

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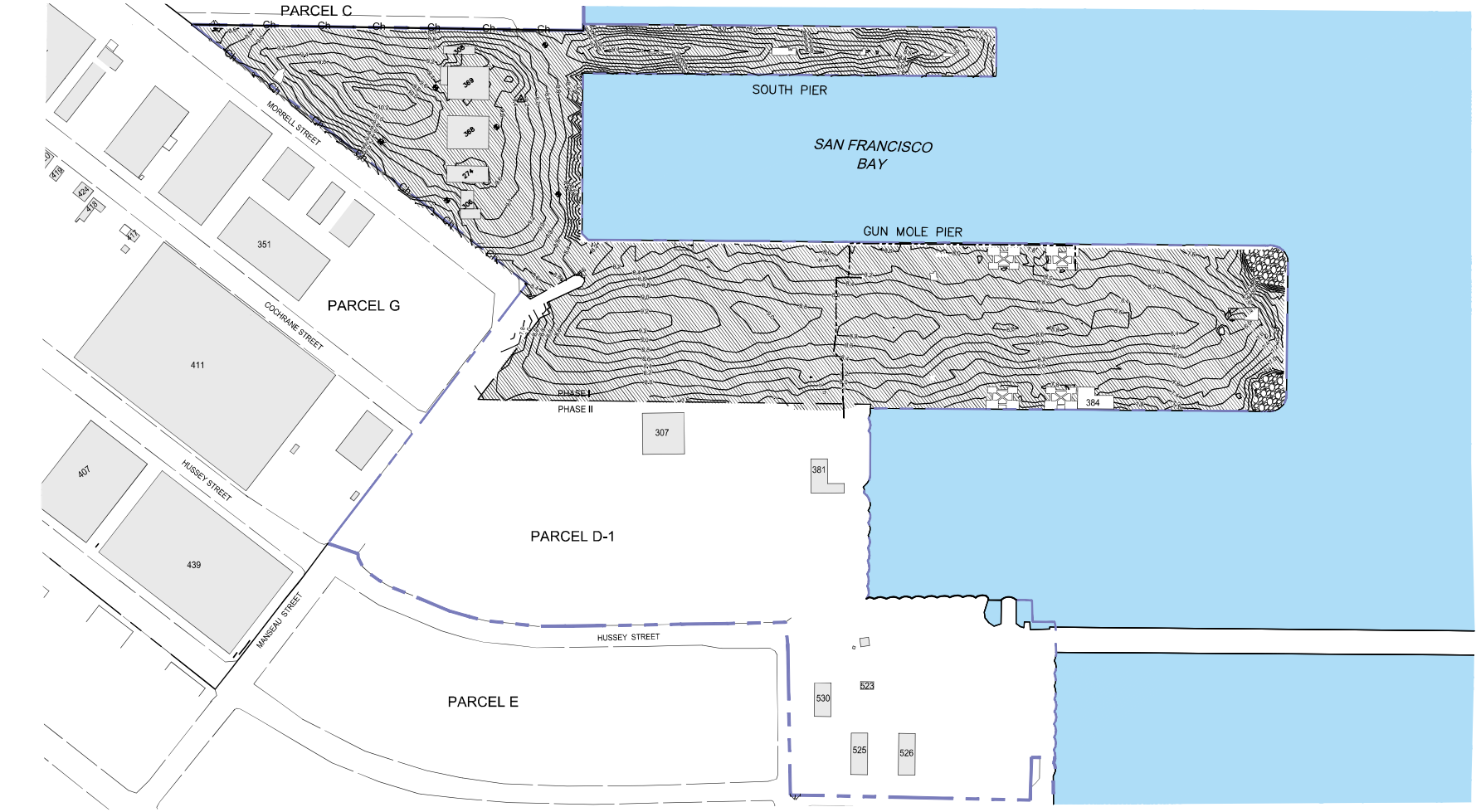

Source:
Innovex-ERRG Joint Venture. 2019. *Fourth Five-Year Review, Hunters Point Naval Shipyard, San Francisco, California.* Figure 7. July.

Figure 5-3
Overview of Remedy Components for Parcel D-1
Fifth Five-Year Review Report
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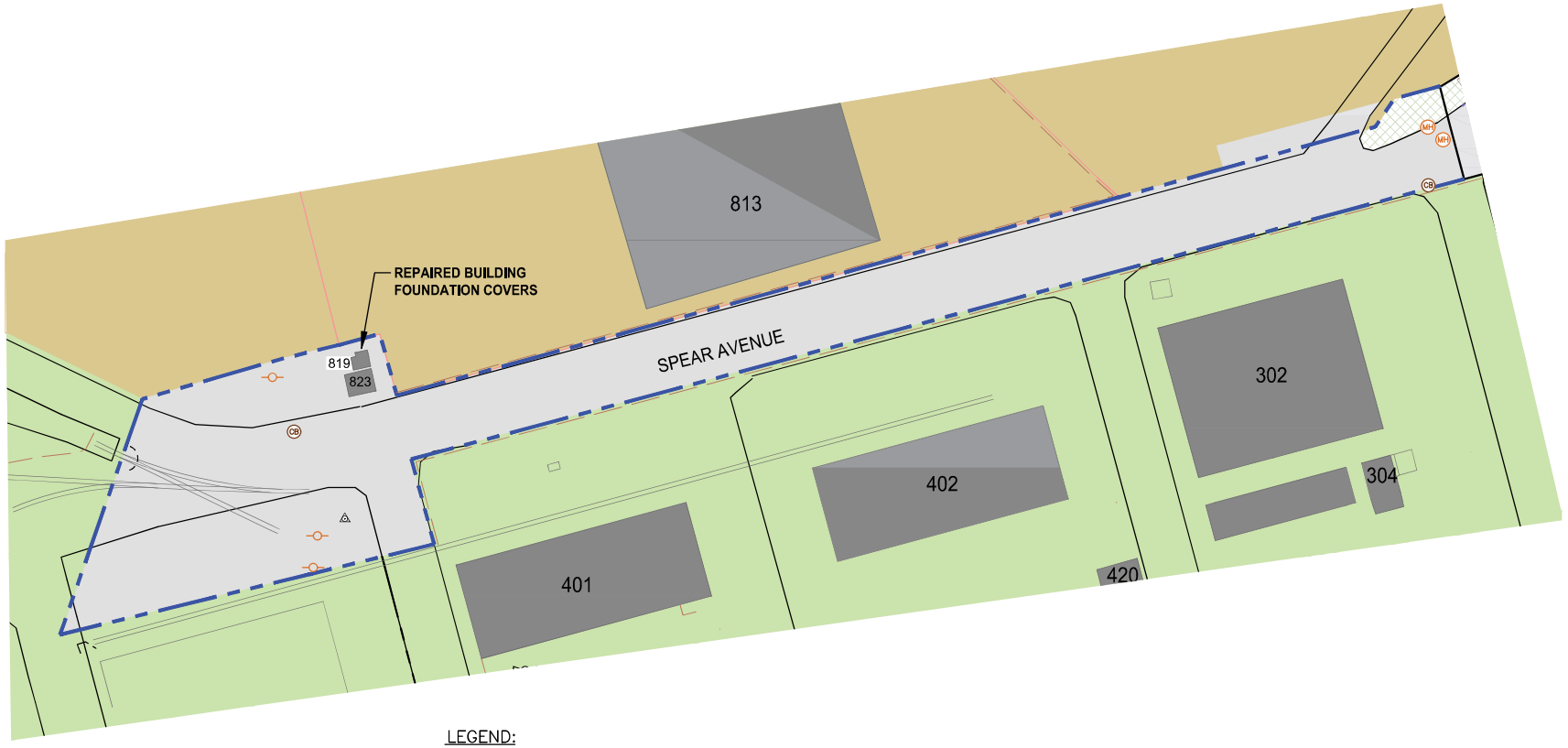

Source:
Innovex-ERRG Joint Venture. 2019. *Fourth Five-Year Review, Hunters Point Naval Shipyard, San Francisco, California.* Figure 11. July.

Figure 5-4
Overview of Remedy Components for Parcel UC-1
Fifth Five-Year Review Report
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San Francisco, California

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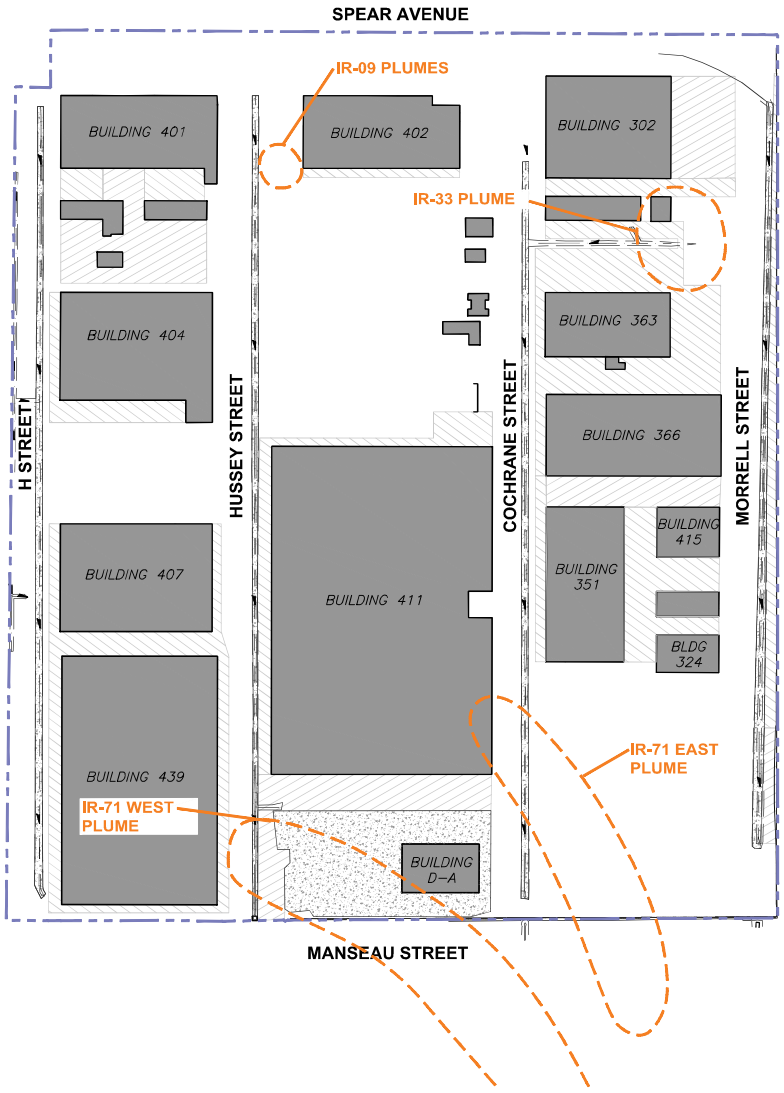

LEGEND:

- SEAL COAT APPLICATION (11%)
- 2" AC OVERLAY ON EXISTING AC (5%)
- CONCRETE PATCHING AND SHOTCRETE (6%)
- CRACK REPAIR/SEALING ON BUILDING SLAB (34%)
- NEW PAVEMENT CONSTRUCTION (44%) (REMAINDER OF SITE)
- DRAINAGE SWALE
- PARCEL BOUNDARY

N

0' 200'

Source:
Innovex-ERRG Joint Venture. 2019. *Fourth Five-Year Review, Hunters Point Naval Shipyard, San Francisco, California.* Figure 10. July.

Figure 5-5
Overview of Remedy Components for Parcel G
Fifth Five-Year Review Report
Hunters Point Naval Shipyard
San Francisco, California

230307115911_589d933e Figure_5-4_G

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6.0 Former Parcel E (Parcels E, E-2, and UC-3)

6.1 Site History and Background

Former Parcel E was used as an industrial support area, including a warehouse (Building 406) where chlorinated solvents were released and Former Oily Waste Ponds (known as IR-03) where spent waste oil was stored from 1944 to 1974. Shoreline areas of Parcel E (known as IR-02) were used to store construction materials and industrial materials, as well as to dispose of industrial waste and construction debris. During its occupancy of HPNS (between 1976 and 1986), Triple A allegedly disposed of hazardous wastes at various locations at HPNS, including possibly discharging waste oil within Parcel E using belowground fuel and steam lines. NRDL conducted research activities within Parcel E, most notably at the former 500 series buildings in the southwestern portion of Parcel E and within the Building 707 Triangle Area which may have discharged small amounts of low-level radioactive liquids into sanitary sewer, storm drain, and septic sewer lines; as a result, sanitary sewer, storm drain, and septic sewer lines throughout Parcel E were identified in the HRA as radiologically impacted. Dials, gauges, and deck markers painted with radioluminescent paint (containing low levels of Ra-226) to make the devices glow in the dark were disposed of along the shoreline (IR-02 and IR-03). Sandblast waste from cleaning ships used during weapons testing in the South Pacific may have been disposed of at IR-02.

Parcel E has been subdivided into Parcels E (128 acres), E-2 (47 acres), and UC-3 (11 acres). Parcel E consists of shoreline and lowland coast along the southwestern portion of HPNS, and contains 17 existing buildings, 25 former buildings, 1 ship berth, numerous IR sites, and future reuse areas (Navy, 2013) (**Figure 6-1**).

The following IR sites are present:

- Parcel E – IR-02, IR-03, IR-04, IR-05, IR-08, IR-11, IR-12, IR-13, IR-14, IR-15, IR-36, IR-38, and IR-39
- Parcel E-2 – IR-01/21
- Parcel UC-3 – Portions of IR-04, IR-52, IR-56, IR-74

Parcel E also includes four IR sites that were established for the former utility network at HPNS: IR-45 (steam line system), IR-47 (fuel distribution lines), IR-50 (storm drain and sanitary sewer systems), and IR-51 (former electrical transformer locations) (ERRG, 2012). Investigations and actions at Parcel E began in 1984, as shown in the following chronology.

Parcel E Chronology	
Date	**Investigation/Action**
1984	Initial Assessment Study
1988–1989	Solid Waste Air Quality Assessment Test
1988	OU RI Phase 1 Reconnaissance
1988–1992	OU-1 RI
1989	Removal of Soil at IR-08 PCB Spill Area
1991	Removal of Floating Product at IR-03

Parcel E Chronology	
Date	**Investigation/Action**
1991–1992	Intertidal Sediment Study
1993	Phase II Radiological Investigation
1994	SI
1996	Exploratory Excavations at IR-11/14/15
1997	RI
1996–1997	Removal of Sediment from the Storm Drain System Phase III Radiological Investigation
1996–1998	Installation of Sheet Pile Wall and Low-Permeability Cap at the Former Oily Waste Ponds in IR-03
1997–1998	FS Groundwater Extraction System and Containment Barrier
1998–1999	Phase IV Radiological Investigation
1999–2000	Parcel E Validation Study and Protective Soil Concentrations Technical Memorandum
2000–2001	Interim Landfill Cap Construction
2000–2002	Groundwater Data Gaps Investigation SVE Treatability Study
2001–2002	Nonstandard Data Gaps Investigation Wetland Delineation and Wetland Functions Assessment
2001	Removal of Soil with Non-VOCs at IR-08 Radiological Investigation of Parcel E Shoreline
2001–2005	Radiological Investigations, Phase V (and other interim investigations)
2002	Standard Data Gaps Investigation
2002–2004	Waste Consolidation and Removal
2002–2003	Construction of Landfill Gas (LFG) Control System
2002–2005	Parcels E and E-2 Shoreline Investigation and Risk Assessment
2003–2004	HRA Parcel E Shoreline Debris Removal
2003	Stockpile Inventory
2003–2004	Removal of Soil Stockpiles
2003– Present	Landfill Gas Monitoring and Control
2004	Removal of TPH-Contaminated Soil from Various Locations Metal Slag Area Characterization

Parcel E Chronology	
Date	**Investigation/Action**
2005–2007	Metal Debris Reef and Metal Slag Area Removal Action Removal of Soil at IR-02 Northwest and IR-02 Central Area PCB Hotspot Area Removal Action (Phase I)
2008	Revised RI, including HHRA and ERA
2009–2011	Groundwater Treatability Study at IR-56
2009–2012	Groundwater Characterization and ZVI Treatability Study at Various VOC Groundwater Plumes
2009—present	Basewide Radiological TCRA and retesting
2010–2012	PCB Hotspot Area Removal Action (Phase II)
2011–2016	Characterization and Treatability Study at IR-03
2011	RI/FS for Parcel E-2
2012	Ship Shielding Area Removal Action Final FS for Parcels E and UC-3
11/2012	ROD for Parcel E-2
2013	Soil Excavation Characterization
12/2013	ROD for Parcel E
1/2014	ROD for Parcel UC-3
2014–2016	Phase 1 Hotspot Removal and Nearshore Slurry Wall Installation Parcel E-2
2016	RD and Design Basis Report and LUC RD for Parcel UC-3
2016–2019	Phase 2 Hotspot Removal, Upland Slurry Wall, Shoreline revetment, and foundation layer installation Parcel E-2
2018	RD for Parcel E LUC RD for Parcel E RACR for Soil Hotspot Excavation, Durable Cover, and Groundwater Remediation Parcel UC-3
2019	Parcel E RA initiation

6.2 Site Characterization

This section summarizes the findings from various investigations at Parcels E, E-2, and UC-3 that are pertinent to the Five-Year Review.

6.2.1 Physical Characteristics

6.2.1.1 Surface Features

Parcels E, E-2, and UC-3 are located in the lowlands of HPNS with surface elevations ranging from 0 to 30 feet above msl; predominant ground surface elevations range from 7 to 10 feet above msl (ERRG, 2012; KCH, 2014). The only surface water features within Parcel E are wetlands areas located along the shoreline. About 30 percent of Parcel E is ruderal habitat

characterized by scattered shrubs and grasses, and about 65 percent is covered by pavement with some sparse vegetation. The remaining 5 percent of Parcel E consists of beach areas, intertidal areas, and wetland areas (ERRG, 2012). Wetlands are also located in the Panhandle Area and Shoreline Area within Parcel E-2 (**Figure 6-1**) (Navy, 2012).

Parcel E contains buildings and paved areas over the northern portion of the parcel and is undeveloped/wetland areas in the southern portion. Parcel E-2 is a landfill with an interim cover (installed in 2000) and open undeveloped areas.

Parcel UC-3 is predominantly paved or open undeveloped land consisting of a railroad right-of-way west of HPNS and an access road (Crisp Road) north of Parcels E and E-2.

6.2.1.2 Geology and Hydrogeology

The Parcels E, E-2, and UC-3 area was created by filling in the bay margin with various materials, including native soil, rock, and sediments, as well as construction and industrial debris (Navy, 2012). Nearly all of the Parcels E, E-2, and UC-3 area was developed from Artificial Fill made up largely of crushed serpentinite bedrock from the hillsides; as a result, high levels of naturally occurring bedrock metals, such as arsenic and manganese, are present in fill materials throughout the parcel.

The following is a summary of hydrostratigraphic units at Parcel E and E-2:

- **A-Aquifer**: The A-aquifer covers almost all of Parcel E, from a few feet to over 50 feet thick. However, the lateral continuity of the A-aquifer is disrupted by numerous low-permeability zones because of the heterogeneous nature of the Artificial Fill. The A-aquifer is unconfined throughout most of Parcel E, but semiconfined conditions may exist in many places where fine-grained sediments below the water table overlie more permeable materials. Depth to groundwater ranges from 4 to 15 feet bgs, with an average depth to groundwater across Parcel E of about 8 feet bgs. A-aquifer groundwater flow patterns at Parcel E are complex. The prominent flow directions are influenced by two major features: (1) the large groundwater sink along the boundary between Parcels D and E, and (2) a groundwater divide in the central shoreline area. The natural flow of groundwater toward the bay from the topographically high area of Parcel A is typically disrupted by these two features (Barajas, 2008). Groundwater at Parcel E generally flows southeast (TRWB, 2022). A groundwater mound exists in the center of Parcel E-2, causing groundwater to flow both east and west. Various groundwater sinks exist across the HPNS, including in the Panhandle and eastern boundary of Parcel E-2 (TRWB, 2022).
- **Bay Mud**: The Bay Mud Deposits range from 5 to 76 feet thick under most of Parcel E (Barajas, 2008). The aquitard is thickest in the southern portion of Parcel E along the shoreline (CES, 2018a). The aquitard is absent in the northern portion of Parcel E, along Crisp Avenue (Parcel UC3), in the northwest corner of Parcel E-2, and in the areas of the bedrock highs (Barajas, 2008; Navy, 2012). In locations where the Mud Bay deposits are absent, the A- and B-aquifers are in hydraulic communication and behave as a single aquifer.
- **B-Aquifer**: Groundwater flow in the B-aquifer is generally toward the southeast. However, groundwater in Parcel E-2 from the B-aquifer flows west from the Panhandle Area to the adjacent offsite properties to the west (TRWB, 2022). Groundwater elevations range from 0 to 2 feet above msl along the western portion of Parcel E-2 and a maximum of 9 feet above msl in the eastern portion of Parcel E-2. Elevations range from 0 feet above msl in the

eastern portion of Parcel E to 5 to 6 feet above msl in the central coastal area of Parcel E (TRBW, 2023).

As discussed in **Section 1.3.4.3**, the entire A-aquifer meets the Resolution 88-63 exception criteria. Although it does not meet the Resolution 88-63 exception criteria, the B-aquifer has a low potential for drinking water use.

6.2.2 Land Use

6.2.2.1 Current Land Use

Parcel E is a former industrial use area with most areas subject to restricted access because of ongoing remediation. Building 606, located in the southeast portion of Parcel E near the Parcel D-1 boundary, is the only occupied building at Parcel E; it is currently leased to the San Francisco Police Department (Navy, 2013). Parcel E-2 is a landfill and Parcel UC-3 is a road and utility corridor.

6.2.2.2 Future Land Use

According to the Redevelopment Plan (SFRA, 1997, OCII, 2018), Parcel E land use will include office and industrial, hotel, infrastructure/utility, multimedia and digital arts, institutional, civic, arts and entertainment, residential, and parks and recreation uses (if not subject to applicable environmental restrictions). The land use at Parcel E-2 will be limited to parks and open space. The future reuse of Parcel UC-3 will be mixed use in the eastern half of Crisp Road that borders Parcel E, and commercial and light industrial uses in the western half of Crisp Road and the railroad right-of-way (AFW, 2016a).

6.2.3 Basis for Taking Action

This section describes the results of site investigations and risk assessments that provide the basis for taking action at Parcels E, E-2, and UC-3. Details for Parcel E are provided in the Revised RI (Barajas, 2008), FS (ERRG, 2012), radiological addendum to the FS (ERRG and RSRS, 2012), RD (CES, 2018a), and Parcel E ROD (Navy, 2013). Details for Parcel E-2 are provided in the RI/FS (ERRG and Shaw, 2011), radiological addendum (ERRG and RSRS, 2011) and Parcel E-2 ROD (Navy, 2012). Details for Parcel UC-3 are provided in the Revised Parcel E RI Report (Barajas, 2008), Parcel E Groundwater Treatability Study (Shaw, 2011), Parcel E radiological addendum (ERRG and RSRS, 2012), Parcel E FS (ERRG, 2012), Parcel E Soil Excavation Characterization (Arcadis, 2013), and Parcel UC-3 ROD (KCH, 2014).

6.2.3.1 Site Investigations and Pre-ROD Removal Actions

Previous investigations at Parcels E, E2, and UC3 identified metals, VOCs, SVOCs, PCBs, pesticides, dioxins and furans, and TPH in soil; methane in landfill gas (Parcel E2); metals, VOCs, SVOCs, PCBs, pesticides, TPH, and anions in groundwater; NAPL at IR-03 (Parcel E); metals, PCBs, and pesticides in sediment; and radionuclides in soil, sediment, groundwater, and structures.

Since the Initial Assessment Study identified several environmental investigation sites in 1984, the Navy has performed multiple environmental investigations at Parcels E, E2, and UC3 to further evaluate IR sites associated with former shipyard operations. The Navy has completed a number of removal actions and treatability studies at Parcels E, E-2, and UC-3. The Navy performed several treatability studies that involved testing technologies to reduce VOCs in groundwater and soil as summarized in the chronology and respective RODs. The Navy has

collected extensive information during these investigations and studies, as well as during ongoing environmental monitoring programs for groundwater (Navy, 2013).

NAPL, both dense NAPL (DNAPL) and/or light NAPL (LNAPL) has been periodically measured in Parcel E (IR Sites 02, 03, and 14, **Figure 6-1**). NAPL at the Former Oily Waste Ponds (IR-03) contains VOCs, SVOCs, PCBs, and TPH that are a source to soil and groundwater contamination (CES, 2018a). The DNAPL typically consists of chlorinated solvents such as PCE and TCE, while the LNAPL typically consists of petroleum hydrocarbons such as fuel and waste oil (TRBW, 2022).

6.2.3.2 Human Health Risk

A quantitative HHRA was completed for Parcel E and UC-3 as part of the Revised RI for Parcel E (Barajas, 2008) and for Parcel E-2 as part of the RI/FS for Parcel E-2 (ERRG and Shaw, 2011). Human health risks were characterized separately for COCs and ROCs. The following unacceptable risks from COCs were identified (**Table 6-1** and **6-2**):

For Parcel UC-3:

- Future industrial workers from exposure to metals, SVOCs (primarily PAHs), and TPH in surface soil (0 to 2 feet bgs), subsurface soil (0 to 10 feet bgs)

For all parcels:

- Future recreational users from exposure to metals, SVOCs (primarily PAHs), pesticides, PCBs, and TPH in surface soil and PCBs in shoreline sediment (0 to 2 feet bgs).
- Future residents (adult and child) from exposure to metals, VOCs, SVOCs (primarily PAHs), pesticides, PCBs, and TPH in surface soil (0 to 2 feet bgs), subsurface soil (0 to 10 feet bgs), and metals and VOCs in A-aquifer groundwater through the vapor intrusion to indoor air pathway and metals, VOCs, SVOCs (primarily PAHs), pesticides, PCBs, and TPH in B-aquifer through domestic use.
- Future construction workers from exposure to metals, VOCs, SVOCs (primarily PAHs), pesticides, PCBs, and TPH in subsurface soil (0 to 10 feet bgs) and SVOCs (primarily PAHs) and lead in A-aquifer groundwater through direct exposure and VOCs in trenches.

Additionally, unacceptable risk from ROCs in soil was identified for future residents, recreational users, and outdoor workers at Parcels E, E-2, and UC-3 (**Table 6-3**) (ERRG and RSRS, 2011, 2012).

6.2.3.3 Ecological Risk

Two assessments of ecological risk evaluations were performed for Parcel E: (I) the baseline ecological risk assessment (BERA), which evaluated risks from exposure to soil in areas planned for open space reuse along the Parcel E shoreline; and (2) the SLERA, which evaluated risks from exposure to sediment in the intertidal zone along the shoreline for both Parcels E and E-2. The BERA found potential risk to birds and mammals from exposure to copper, lead, and total PCBs in soil along the shoreline. The SLERA found potential risk to benthic invertebrates, birds, and mammals from exposure to metals and total PCBs in surface and subsurface sediments along the shoreline and metals, PCBs, pesticides, and total TPH in groundwater (Barajas, 2008; Navy, 2013).

The SLERA for Parcel E-2 evaluated potential risks to wildlife, specifically benthic invertebrates, birds, and mammals, exposed to intertidal sediments at Parcel E-2. The shoreline SLERA

concluded that concentrations of copper and lead in sediment along the Parcel E-2 shoreline are a potential source of contamination to Parcel F. In addition, benthic invertebrates, birds, and mammals are at risk from exposure to PCBs in surface sediments along the Parcel E-2 shoreline (ERRG and Shaw, 2011). Based on the SLERA results, chemical concentrations in soil, shoreline sediment, and groundwater in Parcel E-2 pose a potential threat to wildlife (Navy, 2012). In addition, the SLERA identified COPECs in groundwater for the migration to surface water pathway which include: copper, lead, zinc, un-ionized ammonia, sulfide, cyanide, PCBs, and TPH.

A summary of the COECs identified in the RODs are provided in **Table 6-1** and **6-2** for soil/shoreline sediment and groundwater, respectively.

6.3 Remedial Action Objectives

The ROD for Parcel E was signed in December 2013 (Navy, 2013). **Table 6-4** summarizes the basis for action, RAOs, remedy components, performance metrics, and expected outcomes.

The ROD for Parcel E-2 was signed in November 2012 (Navy, 2012). **Table 6-5** summarizes the basis for action, RAOs, remedy components, performance metrics, and expected outcomes.

The ROD for Parcel UC-3 was signed on January 21, 2014 (Navy, 2014). **Table 6-6** summarizes the basis for action, RAOs, remedy components, performance metrics, and expected outcomes.

The presence of VOCs in groundwater and soil may contribute to the presence of VOC in soil gas, therefore the vapor intrusion pathway is included as a basis for action and development of RAOs for all parcels.

The Navy developed RGs to meet the RAOs for soil, sediment, and RGs and TLs for groundwater which are summarized for COCs/COECs in **Table 6-1** and **6-2**, and for ROCs in **Table 6-3.**

6.4 Remedial Actions

6.4.1 Parcel E

The RA for Parcel E includes the following major components:

- Soil and nearshore sediment excavation and removal to address COCs in soil and nearshore sediment
- Investigation and closure of steam and fuel line system to address potential continuing sources of COCs
- SVE to address VOCs in soil gas
- Durable cover installation to address COCs in soil
- Shoreline protection to address COCs in nearshore sediment and soil
- In situ groundwater treatment for VOCs
- Installation of a belowground barrier to contain COCs and NAPL in groundwater and prevent migration
- Monitoring and MNA of groundwater for VOCs
- Removal and treatment of NAPL source

- Radiological screening and remediation through soil excavation, removal of sanitary sewer and storm drain lines, and FSSs area at three radiologically impacted buildings (404, 414, and 810) and through decontamination (and demolition/dismantling if necessary) buildings, structures, and former building sites
- ICs for to radionuclides

Remedy components are shown on **Figure 6-1, 6-2,** and **6-3.**

6.4.1.1 Remedy Implementation

Remedy construction and implementation is currently underway and is being conducted in phases as described in the Phase 1 RAWP (APTIM, 2019a), Phase 2 RAWP (Gilbane, 2019), and Phase 3 RAWP (APTIM, 2019b). Radiological remediation within Parcel E will be addressed by a future Phase 4 task order, to be completed following the Phase 2 RA and before the unrestricted release of Parcel E. The RA construction began in October 2019 and is currently in progress. The following sections provide the current status of remedy implementation; however, progress at this time has not been documented in a construction completion, or RACR.

Soil Excavation and Removal

Excavation activities were conducted from May 2020 to November 2022 (report pending). The objective of the soil excavation was to remove and dispose of contaminated soil in selected areas (referred to as Tier 1, Tier 2, and TPH locations) that contain nonradioactive chemicals at concentrations exceeding risk-based levels, as well as separate and dispose of materials and soil with radioactive contamination found in these areas.

- Tier 1 locations contain COCs at concentrations greater than 10 times the RGs.
- Tier 2 locations contain COCs at concentrations greater than 5 times the RGs.
- TPH locations contain TPH (commingled with CERCLA-contaminants) at concentrations exceeding the petroleum source criterion (3,500 milligrams per kilogram).

As part of Phase 1 RA, excavation of contaminated material was performed until the Tier 2 soil action levels have been achieved, the excavation reaches 10 feet in depth or bedrock/Bay Mud is encountered, whichever is shallower, or upon the Navy's determination to limit excavation with approval provided in writing by the FFA regulatory parties. Additional excavation may be completed in the event that methane-generating debris is encountered while completing the six nearby source-removal excavations in the IR-12 Area. Additional excavation may also be completed in areas of VOC-impacted soil beneath Building 406 in lieu of SVE if Building 406 has been removed prior to conducting RA (APTIM, 2019a). Building 406 had not been demolished at the time of this review.

In addition, there are 11 planned shoreline excavation areas for the Phase 3 RA at Parcel E (APTIM, 2019b). Shoreline excavation at IR-03 (Phase 2) is discussed in the Nonaqueous Phase Liquid Removal and Treatment section.

Closure of Fuel and Steam Lines

Inactive underground steam and fuel lines located within Parcel E that are potential continuing sources of contamination to soil and/or groundwater will be inspected and either removed or closed-in-place as part of the Phase 1 RA. This work is anticipated to be initiated in spring 2025.

Parcel E contains approximately 2,700 linear feet of inactive underground steam lines that are contained in concrete utilidors (i.e., concrete-lined utility chases) with access points every 200 to 400 feet. Visual inspections and/or sampling will be conducted to evaluate whether individual steam lines, condensate, and pump return lines within Parcel E have been used to transfer waste oil and, if so, whether they leaked onto the concrete utilidors. If the sampling shows that steam lines are contaminated with waste oil, they will be cleaned or removed. Uncontaminated steam lines at Parcel E may be capped and abandoned in place or removed for offsite recycling or disposal (APTIM, 2019a).

Parcel E contains approximately 3,100 linear feet of inactive underground fuel (**Figure 6-3**). Most of the fuel lines are buried directly in soil, although some lines may be located within concrete utilidors. The primary fuel line at Parcel E extends from the Parcels D-1 and E boundary (near former ship Berth 29) to the locations of a former aboveground storage tank (S-505) in IR-02 Southeast, and the Former Oily Waste Ponds (IR-03). The fuel lines will be exposed and inspected to evaluate the condition of the lines, valves, and flanges, and to identify whether fluids or combustible vapors are present in the lines. Residual fluids will be sampled and removed. Fuel lines will be evaluated for potential historic leaks and the surrounding soil will be evaluated for signs of contamination. Fuel lines may be removed or closed-in-place (APTIM, 2019a).

Soil Vapor Extraction

SVE is planned as a source-reduction measure to address VOC-contaminated soil beneath Building 406 in the event that the building has not been removed prior to the time of RA (CES, 2018a). If Building 406 has been removed prior to RA, then excavation may be used in lieu of SVE to remove VOC source material in the area. If Building 406 remains in place, VOCs the vapor intrusion pathway will be evaluated (APTIM, 2019a). This work is anticipated to be initiated in spring 2025.

The following soil gas surveys will be completed: soil gas monitoring at existing VOC plumes at Building 406, IR-04, and IR-12; supplemental methane monitoring will be performed at the potential debris removal area within IR-12; and a focused soil gas survey will be performed in redevelopment areas planned for mixed use to evaluate residual VOCs in soil (APTIM, 2019a).

Durable Cover Installation

The sitewide cover will be composed of either: 1) a minimum 2-foot erosion resistant layer of soil; 2) a minimum 2-inch layer of asphaltic concrete underlain by a minimum 4-inch compacted aggregate base foundation layer; or 3) a minimum 4-foot layer of shoreline armoring comprised of riprap overlying filter rock for steeper slopes (i.e., 3H:1V) and course sand overlying light riprap and filter rock for shallower slopes (i.e., 7H:1V) (APTIM, 2019a). The asphalt and concrete surfaces in the northern portion of Parcel E are part of the future Multi-Use District. The 2-foot-thick soil cover in the southern portion and northwestern edge adjacent to Parcel E-2 are part of the future open space area (CES, 2018a). This work is expected to be initiated in fall 2026.

Shoreline Protection

Shoreline protection will be installed along approximately 3,730 feet of exposed IR-02 shoreline and 550 feet of IR-03 shoreline within Parcel E (**Figure 6-3**). Two separate types of shoreline protection are planned or have been installed:

- **Armored revetment (rock revetment)**: The armored revetment was installed from June 2020 to July 2022 and includes natural rock armor facing (i.e., riprap), with a 3-foot high concrete seawall incorporated into the revetment crest, and will be constructed in the steep and narrow shoreline areas. This revetment has been designed to be stable to wave action and provide protection from exposure to potentially contaminated sediment.
- **Hybrid shoreline stabilization**: The shoreline stabilization will be installed from summer 2023 to summer 2024 and will include natural shoreline materials (i.e., coarse sand) underlain by rock armor (i.e., riprap) and will be constructed in the gradually sloped and wide shoreline areas. This protection measure will provide a more natural look along the shoreline and be more aesthetically pleasing. The primary structural component of the hybrid stabilization design is the underlying riprap rock layer, which is sized based on a worst-case scenario of the rock being exposed to wave action. The overlying sand will improve pedestrian access to shoreline areas and provide an additional layer of protection from exposure to potentially contaminated sediment under the rock armor.

To increase the wave run-up protection level above the +9-foot msl elevation for the armored revetment sections, a 3-foot high concrete seawall will be constructed at the crest of the revetment terminating at elevation 12-feet msl. The seawall is intended to maximize the shoreline protection without substantially increasing the fill volume and associated weight of additional shoreline revetment (CES, 2018a).

In Situ Groundwater Remediation

In situ groundwater VOC treatment will be implemented after the remedial excavations in the treatment area(s) are completed, the performance wells are installed, and baseline sampling conducted (anticipated spring 2025). Groundwater treatment will be completed at the Building 406 Chlorinated VOC (CVOC) Plume, and potentially at the IR-04 CVOC plume, depending on characterization sampling results. Groundwater CVOC plume areas where CVOC concentrations are consistently detected above the GWTDCs (CES, 2018a) will be remediated using in situ bioremediation (ISB) of a carbon source and a dechlorinating microbial consortium injected into the subsurface. In-situ groundwater treatment is intended to be a focused short-term action that enhances degradation of VOCs, at which point MNA and ICs will be relied upon to meet the RAOs (APTIM, 2019a).

Belowground Barrier

A cement-bentonite slurry wall was installed during the Phase 3 RA (from April to July 2020) as a belowground barrier to control discharge of contaminated groundwater. This slurry wall ties into the previously installed Parcel E-2 nearshore slurry wall and extends to the southeastern limits of IR-02 Northwest. The total length of the IR-02 Northwest slurry wall is approximately 1,090 feet, including a 20-foot-long overlap with the Parcel E-2 nearshore slurry wall to form a continuous low-permeability barrier between the two parcels (APTIM, 2019b).

A second slurry wall will be installed at IR-03 as discussed in the Nonaqueous Phase Liquid Removal and Treatment section.

Groundwater Monitoring

Groundwater monitoring wells and soil gas monitoring points will be installed in VOC-impacted plumes located near Building 406 (IR-36), IR-04, IR-12A, and IR-12B to monitor remedial progress. In addition, groundwater monitoring wells will be installed in remedial excavation areas after backfilling activities are completed to replace wells required for Phase 1 groundwater

monitoring. Groundwater and soil gas monitoring will be conducted at IR-36 to support the selected remedy, including documenting the beneficial impact to groundwater quality following implementation of ISB (APTIM, 2019a).

Ten monitoring wells and piezometers will be installed during Phase 2 to complete the RA monitoring well network. The design of the IR-03 slurry wall includes monitoring wells and piezometers to measure groundwater levels and the hydraulic gradient across the IR-03 slurry wall. Existing groundwater monitoring wells within the IR-03 area will be removed during the site preparation phase, and new monitoring wells and piezometers will be installed after the IR-03 slurry wall and ISS are constructed.

Groundwater is currently sampled through the BGMP. Groundwater monitoring wells screened in the A-aquifer are sampled for VOCs, metals, PCBs, pesticides, and TPH. Radionuclides are also sampled at Parcel E to demonstrate, consistent with previous radiological investigations, that radionuclides are not present in groundwater at activity levels that are both statistically significant and pose an unacceptable risk to human health and the environment (TRBW, 2022b). Exceedances of the RGs (identified as PALs) from 2019, 2020, 2021, and 2022 are presented in **Appendix E**. Nickel, zinc, naphthalene, total TPH, and VC have exceeded the RGs and/or TLs in one or more locations during this review period. While these exceedances were identified, the locations are upgradient of the slurry wall, which was designed to contain the metals and other chemicals, preventing discharge to surface water.

The current monitoring program will continue in accordance with the selected remedy identified in the ROD (Navy, 2013). Additional sampling is also being conducted to support the multiple phases of RA being completed in Parcel E. Once RA is completed in Parcel E, then the monitoring program will be conducted in accordance with the RAMP (CES, 2019).

Nonaqueous Phase Liquid Removal and Treatment

NAPL will be addressed at Parcel E through a combination of excavation, ISS treatment, and a slurry wall (Gilbane, 2019). A summary of the planned actions are as follows:

- Shoreline excavation of NAPL up to the Bay Mud Layer was completed at IR-03 from August 2021 to April 2023.
- ISS treatment will be initiated in August 2024 and will consist of bentonite slurry and cement grout mixed with the soil to create a solidified and stabilized soil-bentonite-cement monolith. The anticipated ISS area is approximately 69,000 square feet, with the estimated target zone of soil ranging from 12 to 30 feet bgs. The ISS treatment at IR-03 is targeted to areas with the highest total TPH concentrations (i.e., greater than 9,000 milligrams per kilograms), indicating that high-saturation and mobile NAPL are present (Gilbane, 2019).
- A cement-bentonite slurry wall will be constructed at IR-03 and the surrounding area (**Figure 6-3**). Construction is planned for December 2024. The IR-03 slurry wall will encompass the extent of known groundwater contamination, including areas with elevated TPH concentrations in soil that may serve as secondary sources, providing a low-permeability barrier to prevent or minimize flow of contaminated groundwater toward San Francisco Bay from areas upgradient of the wall. A cement-bentonite backfill mix is proposed for the IR-03 slurry wall, which will create self-hardening slurry that will act as both the trench stabilizing slurry and the final backfill material (Gilbane, 2019).

During the Phase 2 shoreline excavation, a temporary sheet pile wall will be installed along the excavation area to provide stability for the shoreline and prevent releases to the San Francisco Bay during excavation (Gilbane, 2019).

Radiological Surveys and Remediation

The ROPCs at Parcel E include Co-60, Cs-137, Ra-226, Sr-90, U-235, Pu-239, and americium-241 (Am-241) (Navy, 2013).

The Navy conducted TCRAs to address potential radioactive contamination in the interior Parcel E area, including storm drains and sanitary sewer lines and radiologically impacted structures (TtEC, 2012a). In total, 6,984 cubic yards of soil were excavated during removal of 5,131 linear feet of sanitary sewer and storm drain lines. Approximately 177 cubic yards of soil was disposed of offsite as LLRW based on surface scan and analytical laboratory results. FSSs were performed within the interior Parcel E area at three radiologically impacted buildings (404, 414, and 810), three radiological sites (Building 701 Site, Building 704 Site, and the IR-04 Former Scrap Yard Site, which includes the former Building 807 Site) (TtEC, 2012b). Additionally, FSSs were performed at other areas within Parcel E at 13 radiologically impacted buildings (406, 500, 509, 521, and 529) and 7 radiological sites (Former Building 500 Series, Former Building 503 Site, Former Building 506 Site, Former Building 507 Site, Former Building 508 Site, Former Building 510/510A Site, Former Building 517 Site, Former Building 520 Site, Building 707 Triangle Area, and Former Shack 79 and 80 Site) (TtEC, 2010, 2012c, 2012d, 2012e, 2012f, 2013a, 2013b, 2013c, 2013d, 2013e, 2013f, 2013g, 2014, and 2016).

The TCRA data was reviewed as described in **Section 1.4.3** and radiological retesting, including sampling and surveys of soils previously investigated during sanitary sewer line storm drain removal and resurvey of impacted buildings and former building sites, is currently being conducted to determine if current site conditions are compliant with the RAOs.

Institutional Controls

The entire area of Parcel E (about 128 acres) is subject to ICs. IR-02 (Former Disposal Areas) and IR-03 (Former Oily Waste Ponds) are subject to ICs specifically related to radionuclides (**Figure 6-2**). IC performance objectives were developed and presented in the LUC RD (CES, 2018b). The IC performance objectives to be implemented through land use restrictions for the site are summarized in **Table 1-3**. The Navy currently controls land use and access to the Parcel while RAs are ongoing.

6.4.1.2 Remedy Operations and Maintenance

Because remedy construction is ongoing, there are no O&M activities.

6.4.2 Parcel E-2

The RA for Parcel E-2 includes the following major components:

- Excavation and disposal of COCs in soil and sediment and debris and construction of tidal and non-tidal wetlands
- Durable cover installation to address COCs in soil and landfill material
- Installation of a belowground barrier (slurry wall) to contain COCs in groundwater and prevent migration
- LTM of groundwater for COCs

- Landfill gas monitoring, collection, and treatment
- Radiological screening and remediation through conducted TCRAs
- ICs for land use

Remedy components are shown on **Figure 6-1, 6-2,** and **6-4.**

6.4.2.1 Remedy Implementation

Soil, Sediment, and Debris Excavation, Consolidation, and/or Removal

Hotspot delineation and excavation of contaminated materials in Parcel E-2 was conducted over two phases. Phase I was completed from June 2005 to September 2006. The Phase 1 TCRA at the PCB Hotspot Areas was performed to remove contaminated soil and debris, possibly containing low-level radioactive material. The removal action goals included removal of free-phase petroleum hydrocarbons to a practical extent. Approximately 44,500 cubic yards of contaminated soil, including 611 cubic yards of material with radionuclides, was excavated from this area in the southeast portion of Parcel E-2. From March 2010 to November 2012, a Phase 2 TCRA at the PCB Hotspot Areas was performed to remove contaminated soil and debris from the shoreline portion of the PCB Hotspot Area, and other select hotspots identified in the RI/FS Report. Approximately 42,200 cubic yards of contaminated soil and 3,000 cubic yards of large debris were excavated from areas not addressed during the Phase 1 TCRA (KEMRON, 2018). Because all hotspots identified for removal in the TCRAs were not removed at the time the ROD was in preparation, the remaining hotspot removal was incorporated into the remedy.

From November 2014 through March 2016, the remaining Hotspots in Parcel E-2 as determined by the Design Basis Report (DBR) (ERRG, 2014) were excavated as part of the Phase 1 Parcel E-2 RA. Approximately 39,000 BCY of PCB, TPH, lead, copper and PCE-contaminated soil were excavated from within the Panhandle, Shoreline, and East Adjacent Areas. In addition, approximately 5,324 BCY of soil and debris were excavated prior to installation of the nearshore slurry wall, and another 3,499 BCY of material were trenched during slurry wall installation (Gilbane, 2018a).

As part of the Phase 2 RA, the tidal and freshwater wetland areas were excavated and graded to the subgrade design as specified in the DBR (ERRG, 2014). Approximately 51,902 cy of soil, sediment and debris was excavated and radiologically screened from the tidal and freshwater wetland. While grading within the vicinity of the freshwater wetland, approximately 1,204 cy of material suspected of containing methane-generating debris were removed (APTIM, 2021). During the Phase 3 RA, the contractor will build approximately 3.18 acres of tidal wetlands and approximately 1.59 acres of freshwater wetlands in the Panhandle Area in accordance with the DBR (ERRG, 2014; KEMRON, 2018). The tidal and freshwater wetland installations are anticipated to be completed in 2027.

Waste generated during RA construction and grading activities, including soil, sediment, and non-recyclable or non-reusable debris, provided it met the consolidation criteria, was consolidated on site to establish the top of foundation layer elevation (ERRG, 2014). Radiologically cleared debris such as concrete, bricks, timber, metal, etc., were resized and reshaped as necessary, and buried at least 5 feet below the final protective layer to minimize the potential for damage to the final cover system. This depth was specified to result in a minimum cover thickness of 7 feet over consolidated debris, corresponding to 3 feet of cover fill over the debris, 2 feet of foundation layer soil, and 2 feet of cover soil over the liner. Based on the foundation grading plan, the northwest area of the landfill was selected for the waste (i.e.,

debris) consolidation area because it had the greatest capacity to receive waste while meeting the waste consolidation criteria established within the DBR (ERRG, 2014). An estimated 9,754 cy of debris was generated during grading operations (APTIM, 2021).

Durable Cover Installation

Durable covers at Parcel E-2 were constructed under the Phase 3 RA and completed in fall 2023. They consist of vegetated soil cover over the entire parcel as follows:

- A minimum 2-foot-thick foundation soil layer consisting of radiologically cleared soil located directly beneath a protective liner.
- A minimum 2-foot-thick soil cover (vegetative soil layer) with protective liner and demarcation layer in non-wetland areas, and a minimum 4-foot-thick soil cover in the new wetlands directly over the foundation layer, in accordance with the DBR (ERRG, 2014).
- A demarcation layer will be installed at the bottom of the vegetative soil cover where necessary to mark the potential presence of remaining radiological hazardous substances.
- All non-wetland areas will be covered with a protective liner that will include a geocomposite drainage layer. In non-wetland areas that are radiologically impacted, the upper layer of geotextile fabric within the geocomposite drainage layer will also serve as the demarcation layer. That is, the upper layer of fabric will be orange-colored and overlain by magnetic marking tape, and will then be covered by 2 feet of soil (KEMRON, 2018).

Radiologically cleared soil was reused for construction of the final foundation layer. A portion of the foundation layer and the remaining layers of the covers are pending installation.

Shoreline Revetment

The shoreline revetment was installed along approximately 1,800 feet of shoreline where Parcel E-2 meets Parcel F. The revetment is approximately 35 feet wide with a crest elevation of +9 feet msl. A concrete seawall is incorporated into the crest of the revetment to protect against additional wave run-up from the design storm conditions (CB&I, 2016; APTIM, 2021). During the installation of the shoreline revetment an additional excavation 6 feet into Parcel F was completed to assure the integrity of the revetment structure during future remediation activities within the San Francisco Bay (APTIM, 2021). After the installation of the shoreline revetment, 4 piezometers, 3 monitoring wells, and 13 leachate monitoring/extraction wells were installed, predominantly in accordance with the DBR (ERRG, 2014; APTIM, 2021).

Belowground Barrier (Slurry Walls)

Two belowground barriers were installed as follows:

- A nearshore cement-bentonite slurry wall was installed during the Phase 1 Parcel E-2 RA to control discharge of contaminated groundwater. This slurry wall was installed near the shoreline adjacent to the Parcel E-2 Landfill and eastern boundary of the parcel (**Figure 6-4**). The nearshore slurry wall extends about 1,250 feet along the western edge of the landfill waste, to the Parcel E boundary to the south. It is aligned with the shape of the Parcel E-2 shoreline to prevent groundwater located bayward of the landfill waste from contacting surface water in San Francisco Bay and divert nearshore groundwater flow to the southeast toward adjacent Parcel E (Gilbane, 2014). At Parcel E-2, an aquitard exists in the form of a Bay Mud layer, the top of which is located between 4 and 18 feet bgs. The specifications dictated that the nearshore slurry wall would be keyed a minimum of 2 feet into the Bay Mud aquitard, and would extend up to 2.5 feet below the design finish grade (ERRG, 2014).

- An upland cement-bentonite slurry wall was installed during Phase 2 Parcel E-2 RA. As designed, the upland slurry wall extends approximately 571 feet from the northern parcel boundary to the southern extent of the landfill waste in the western portion of Parcel E-2 (ERRG, 2014; APTIM, 2021). It is aligned perpendicular to the direction of groundwater flow in the western portion of the site to divert upgradient offsite groundwater away from groundwater that contacts landfill waste. As designed, the upland slurry wall is considered a "hanging" slurry wall because it was not intended to key into an aquitard. The upland slurry wall was designed to be installed from the planned finish grade, down through a thin noncontiguous lens of Bay Mud, to an elevation of approximately -10 feet below msl. Some groundwater will flow under the upland slurry wall, but groundwater modeling predictions (ERRG, 2014) indicate that upgradient flow will mostly be diverted around the upland slurry wall or diverted to the freshwater wetland via a French drain installed on the upgradient side of the upland slurry wall to divert groundwater and surface water runoff to the freshwater wetland (APTIM, 2021). The French drain consisted of a buried 4-inch perforated schedule 80 PVC pipe embedded within the trench filled with gravel and geofabric (APTIM, 2021).

Landfill Gas Controls and Monitoring

During the Phase 3 RA, a new gas control and collection system (GCCS) is anticipated to be installed in 2024 or 2025, consisting of active LFG extraction wells; conveyance piping; an extraction blower; a methane and non-methane organic compounds (NMOC) LFG treatment system; an existing LFG collection trench; subsurface methane monitoring probes, and methane monitoring points throughout the GCCS to monitor its successful operation. An existing barrier wall and LFG collection trench was installed from August 2002 to May 2003 along the northern Parcel E-2 boundary to address LFG migration beneath the University of California San Francisco (UCSF) facility. The barrier is approximately 1,475 feet long and consists of interlocking high-density polyethylene panels installed to depths below the water table in that region. The LFG collection trench was installed between the barrier wall and the landfill waste. It consists of a perforated pipe wrapped with geotextile and set above the seasonal high water table and surrounded with backfilled sand and gravel. Ten SVE wells will be decommissioned and 34 LFG extraction wells installed. Major components of the LFG treatment facility include an electric blower; activated carbon and potassium permanganate pre-treatment adsorptive filters to remove NMOCs; an enclosed ground flare to oxidize methane; and a condensate collection and storage system. The LFG treatment facility will be located in the East Adjacent Area. Eighteen additional gas monitoring probes will be installed to complete the network (KEMRON, 2018).

The purpose of monitoring the landfill surface is to confirm that the remedy (including the GCCS, soil cover, and protective liner) is inhibiting emissions of fugitive LFG and maintaining ambient concentrations of NMOCs less than site-specific action levels (KEMRON, 2018).

Groundwater Monitoring

Groundwater is sampled through the BGMP. At Parcel E-2 groundwater LTM was initiated in 2012 and consisted of sampling 13 groundwater monitoring wells screened in the A-aquifer and B-aquifer for VOCs, SVOCs, metals (including chromium VI), PCBs, pesticides, and TPH. Radionuclides are also sampled at Parcel E-2 to verify that ROPCs are not being mobilized in groundwater. Exceedances of the RGs or TLs (identified as PALs) from 2019, 2020, 2021, and 2022 are presented in **Appendix E**. Arsenic, cyanide, un-ionized ammonia, and TPH have exceeded comparison criteria in one or more location during one or more sampling events

during this review period. The monitoring wells are all located upgradient from the slurry wall discussed in the previous section.

The RA is in progress and the monitoring network has been changed throughout construction activities due to well decommissioning, access, and/or other issues to prevent sampling. Therefore, monitoring data do not provide insight into the effectiveness of the RA but can provide pre-RA completion baseline information.

The current monitoring program will continue in accordance with the selected remedy identified in the ROD (Navy, 2012). RA is currently being conducted in Parcel E-2 in accordance with the Final Design Basis Report (ERRG, 2014) and Work Plan (CB&I, 2016). Once the RA is completed the Parcel E-2 data will be collected as part of the BGMP.

Radiological Surveys and Remediation

The ROPCs at Parcel E-2 include Co-60, Cs-137, Ra-226, and Sr-90 (Navy, 2012). The Navy conducted TCRAs at Parcel E-2 to address potential radioactive contamination at several areas, including the PCB Hotspot Area, Metal Slag Area, and Ship Shielding Area (Gilbane, 2018a) and is addressing potential residual radioactive contamination at the Parcel E-2 landfill and adjacent areas through RAs (APTIM, 2019a, 2019b, 2021; Gilbane, 2019).

Institutional Controls

The entire area of Parcel E-2 (about 47 acres) is subject to ICs. IC performance objectives were developed and presented in the LUC RD (CES, 2018b). The IC performance objectives to be implemented through land use restrictions for the site are summarized in **Table 1-3**. The Navy currently controls land use and access to the parcel while RAs are ongoing.

6.4.2.2 Remedy Operations and Maintenance

Because remedy construction is not complete and is ongoing, there are no O&M activities related to the RA. However, O&M activities related to the existing landfill and landfill gas monitoring are ongoing.

Landfill Cap Inspections

The existing landfill cap area is inspected to ensure the integrity of the interim landfill cap and landfill gas control and monitoring system (Tetra Tech, 2003). The inspection typically includes inspecting the property fence, gas vents, vegetation and irrigation system, burrowing animals and deterrent system, and conducting settlement surveys. Since the remedy construction was initiated in 2019 vegetation and the top foot of soil, irrigation system, and burrowing animal deterrents were removed and settlement surveys were discontinued until the final remedy is in place (INYA, 2022).

Landfill Gas Monitoring

Landfill gas is currently monitored and reported in accordance with the Final Interim Landfill Gas Monitoring and Control Plan (Tetra Tech, 2004). Methane concentrations were generally below action levels until spring 2020 when methane exceeded action levels at the fenceline. Concentrations remained generally below action levels until July 2021 and December 2021 when the active venting system was turned on and powered by a generator beginning in January 2022 (INYA, 2022). The system is currently operational and powered by solar power (INYA, 2023). Methane concentrations were below action levels after the system was turned on until December 2022 when methane exceeded action levels at the fence line again. The exceedance was being investigated at the time the quarterly report was being prepared (INYA,

2023). Methane concentrations did not exceed at the monitoring points on UCSF property during October 2018 to December 2022 monitoring period. NMOC concentrations have been below action levels for all monitoring areas through the period from January 2019 until December 2022 (INYA, 2023). On June 21, 2023, the Navy detected a methane gas reading above the State of California action level at an HPNS landfill gas monitoring probe (GMP-07). The probe is located inside the newly installed landfill cover and is no longer representative of a perimeter monitoring point. To confirm that the methane levels are below action levels at a boundary location, a new monitoring probe was installed on October 13, 2023 (GMP-54). Measurements were collected in October through December with no detections of methane with the exception of a reading of 0.1 percent on October 31, below the action level of 5 percent by volume. Details and data are provided in **Appendix H.**

Upon notification of the reading, the Navy notified UCSF, the California Department of Recycling and Recovery, and the HPNS Base Closure Team. The Navy has increased the frequency of monitoring at the gas monitoring probe with the elevated reading to determine if this was an isolated case. To date, readings continue to remain elevated at that location. To provide protectiveness of human health, the Navy is measuring the air to confirm no methane is escaping from the gas monitoring probe or the landfill perimeter. The Navy has not detected any methane. The Navy will maintain the increased monitoring frequency through resolution of this situation and is collaborating with regulatory agencies to resolve the methane issue.

6.4.3 Parcel UC-3

The RA for Parcel UC-3 includes the following major components:

- Soil hotspot excavation and removal to address COCs in soil
- Steam line closure
- Durable cover installation and maintenance to address COCs in soil
- Soil gas sampling to identify areas impacted by VOCs
- In situ treatment and MNA for VOCs in groundwater
- Radiological surveys and remediation through soil excavation, removal of sanitary sewer and storm drain lines, and TCRAs
- ICs for soil and groundwater

Remedy components are shown on **Figure 6-1, 6-2,** and **6-5.**

6.4.3.1 Remedy Implementation

Soil Hotspot Excavation and Removal

Soil excavations were conducted in April and November 2017 to remove soil to levels below 5 times the RG for residential exposure. Three hotspot areas were excavated for a total of 783 cubic yards. Excavations were backfilled with clean fill. Response complete for soil was documented in the RACR for Parcel UC-3 (Gilbane, 2018c).

Steam Line Closure

As discussed in the Parcel E summary, the steam lines at HPNS may have been a source of contamination so steam line closure was included as a remedy component. Steam line closure RAs for Parcel UC-3 were determined post-ROD to be unnecessary to protect human health and the environment because (1) the portion of the steam line within Parcel UC-3 was not used

for conveying oil; (2) the portion of the steam line system within Parcel UC-3 was assessed during previous site investigations with no evidence of contamination; and (3) the portions of the steam line system within Parcel UC-3 are outside of the area where previous investigations identified waste oil impacts in the steam lines (AFW, 2016a).

Durable Cover Installation

Durable covers consisting of asphalt concrete were installed in the eastern portion of Crisp Road to eliminate the exposure pathway for residual contamination left in place (**Figure 6-5**). Durable covers were not required in the railroad right-of-way or on Crisp Road between the right-of-way and Redevelopment Block MU-3. Completion of the durable covers along with ICs as discussed in **Section 1.3.4.2** meets the RAOs for soil in Parcel UC-3; response complete is documented in the RACR for Parcel UC-3 (Gilbane, 2018c). Covers consisted of:

- Existing asphalt concrete pavement that did not require repairs
- Existing concrete sidewalks and concrete utility trench and covers
- Repaired asphalt concrete to a minimum 4-inch thickness
- Newly installed minimum 4-inch-thick asphalt concrete over areas where a cover had not been or where the existing pavement could not be repaired

Soil Gas Monitoring

A soil gas survey was conducted to confirm whether the ARIC for potential VOCs in groundwater and soil gas was warranted. Samples were collected from three soil gas probes in May 2017 and benzene exceeded the project screening goal of 8.39 micrograms per cubic meter with a concentration of 10 micrograms per cubic meter, resulting in the retention of the ARIC (Gilbane, 2018c).

In situ Groundwater Remediation and Monitoring

ISB and MNA were selected in the ROD to reduce VOCs, specifically TCE, in groundwater; however, based on historical and current (2018) data, TCE concentrations were below RGs since 1996 and below the 2.9 µg/L vapor intrusion criteria since 2009 (Gilbane, 2018c). Additional remediation for groundwater was not warranted since TCE concentrations were below RGs and natural attenuation processes had effectively reduced COCs below vapor intrusion criterion. Since RGs were met, groundwater is response complete for unlimited use/unrestricted exposure which is documented in the RACR for Parcel UC-3 and no further groundwater sampling is warranted (Gilbane, 2018c).

Radiological Surveys and Remediation

The ROCs suspected to be present at Parcel UC-3 include Cs-137, Ra-226, and Sr-90 (Navy, 2014). The Navy conducted TCRAs at Parcel UC-3 to address potential radioactive contamination in storm drains and sanitary sewer lines (TtEC, 2012a). In total, approximately 18,024 cubic yards of soil were excavated during removal of approximately 18,363 linear feet of sanitary sewer and storm drain lines. Approximately 1,879 cubic yards of soil was disposed of offsite as LLRW based on surface scan and analytical laboratory results.

The TCRA data was reviewed as described in **Section 1.4.3** and radiological retesting, including sampling and surveys of soils previously investigated during sanitary sewer line storm drain removal and resurvey of impacted buildings and former building sites, is currently being conducted to determine if current site conditions are compliant with the RAOs.

Institutional Controls

The entire area of Parcel UC-3 (about 11 acres) is subject to ICs prohibiting growing produce in native soil and use of groundwater. The portion of Parcel UC-3 that is adjacent to Parcel E is also subjected to general soil and groundwater ICs and a small portion is subject to ICs related to VOCs (**Figure 6-2**). IC performance objectives were developed and presented in the LUC RD (AFW, 2016b). The IC performance objectives to be implemented through land use restrictions for the site are summarized in **Table 1-3.**

6.4.3.2 Remedy Operations and Maintenance

Ongoing O&M at Parcel UC-3 includes maintaining the integrity of the durable covers and IC inspections. The inspection and maintenance requirements for the durable covers are described in the Final O&M Plan for Parcel UC-3 (Gilbane, 2018b). AOMSRs are prepared to summarize inspections and maintenance performed and to document the effectiveness of the remedy components. AOMSRs from 2019, through 2023 were reviewed (Innovex-ERRG Joint Venture, 2020, 2021a; APTIM, 2022, 2023).

Durable Cover Maintenance

In general, the durable covers were in good condition with some minor deterioration around metal trench plates and a storm drain that were repaired in 2022 (APTIM, 2023). The metal trench plates were installed to temporarily cover sections of the road that were deteriorated but are frequently used by heavy trucks during RA activities at Parcels E and E-2.

Institutional Controls Compliance

ICs are inspected annually, and no deficiencies or inconsistent uses were observed during the reviews. General site conditions were determined to be good. Remedy components such as survey benchmarks and monitoring well vault covers were found to be in good condition.

Navy controls access to the portion of the parcel adjacent to Parcel E using security fencing, signage, locks, and gates which were found to be in good condition, with no signs of damage or vandalism. The remaining portion of the parcel did not show any indications of incompatible land use.

6.4.4 Progress Since the Fourth Five-Year Review

Issues, recommendations, and follow-up actions from the Fourth Five-Year Review are summarized in **Table 6-7.**

6.5 Technical Assessment

While the remedy construction is not complete for Parcels E and E-2, evaluation of Technical Assessment Question A is not feasible. However, because the RODs were signed in 2013 and 2012, respectively, Technical Assessment Question B is evaluated. Because the remedy is still under construction, the Navy considers a Will Be Protective determination to be appropriate for Parcels E and E-2.

6.5.1 Question A: Is the Remedy Functioning as Intended by the Decision Document?

6.5.1.1 Parcel E

Technical assessment related to remedy function was not conducted because the remedy is still under construction. However, the remedy is being constructed in accordance with the

requirements in the ROD (Navy, 2013), Design (CES, 2018a), and RAWPs (APTIM, 2019a, 2019b; Gilbane, 2019). Controls such as a temporary sheet pile wall and silt fencing are in place to prevent erosion and migration of subsurface contaminants during construction.

6.5.1.2 Parcel E-2

Technical assessment related to remedy function was not conducted because the majority of the remedy is still under construction or O&M data collection is still in progress for an evaluation. However, the remedy is being constructed in accordance with the requirements in the ROD (Navy, 2013), DBR (ERRG, 2014), and RAWP (KEMRON, 2018). The nearshore slurry wall has been constructed; hot spots have been excavated and removed; and a portion of the landfill cover base has been installed (Gilbane, 2018a). The remaining remedy construction is ongoing. Landfill gas is being monitored under the interim monitoring plan, and active venting is ongoing to reduce methane concentrations to below action levels at the points of compliance. While the remedy is currently under construction, agency concerns have been raised regarding the following completed components:

- **Concern: The Upland Slurry Wall was not installed as designed**. Geologic refusal was met along a 200-foot section of the planned wall at approximately 0 feet msl (10 feet shallower than the designed depth). The slurry wall was designed to minimize flow of offsite groundwater into the landfill and was designed as a “hanging wall” (not embedded into bedrock) with a French drain (which was installed according to the design) to prevent precipitation recharge and divert flow to the freshwater wetland. The material encountered was determined to be bedrock, which has a lower permeability than the surrounding aquifer material. A work plan is under agency review to evaluate the Upland Slurry Wall performance and work is anticipated to begin in 2025.
- **Concern: The turbidity curtain was not used during remedy construction.** A 2,000-foot U.S. Department of Transportation Type III offshore turbidity curtain was installed during shoreline work in accordance with the Design (ERRG, 2014) on November 30, 2016, as documented in the Phase II Remedial Action Construction Summary Report (APTIM, 2021). The turbidity curtain was removed after shoreline activities were completed, in accordance with the RAWP Appendix D, Environmental Protection Plan (CB&I, 2016) which states the following: “During shoreline earthwork (revetment installation, wetlands excavation, and site grading), a turbidity curtain will be deployed as the BMP for sediment control.” Upcoming nearshore work, such as wetland installation, will be conducted in accordance with the design and RAWP.
- **Concern: The Navy has not provided all stormwater best practices documentation.** The Navy provided the following final primary documents that contain stormwater best practices: Remedial Action Work Plans (RAWPs) (CB&I, 2016; KEMRON, 2018); Stormwater Protection Plan; and stormwater best practices monitoring documentation during construction (provided in the Phase I RACR [Gilbane, 2018a] and Phase II RACSR [APTIM, 2021], which will also be provided in the forthcoming Phase III RACSR [pending]). The Navy also responded to the Water Board’s December 3, 2022, January 11, 2023, and May 23, 2023, follow-up email requests for stormwater records.
- **Concern: There is not adequate documentation that lead was removed from the wetland areas and groundwater may be affected in the future.** Lead was removed from the tidal wetland areas according to the Phase II RAWP (KEMRON, 2018) and subsequent Fieldwork Variance #5 (Appendix G of APTIM, 2021). Exceedances shown on Figures 6 and